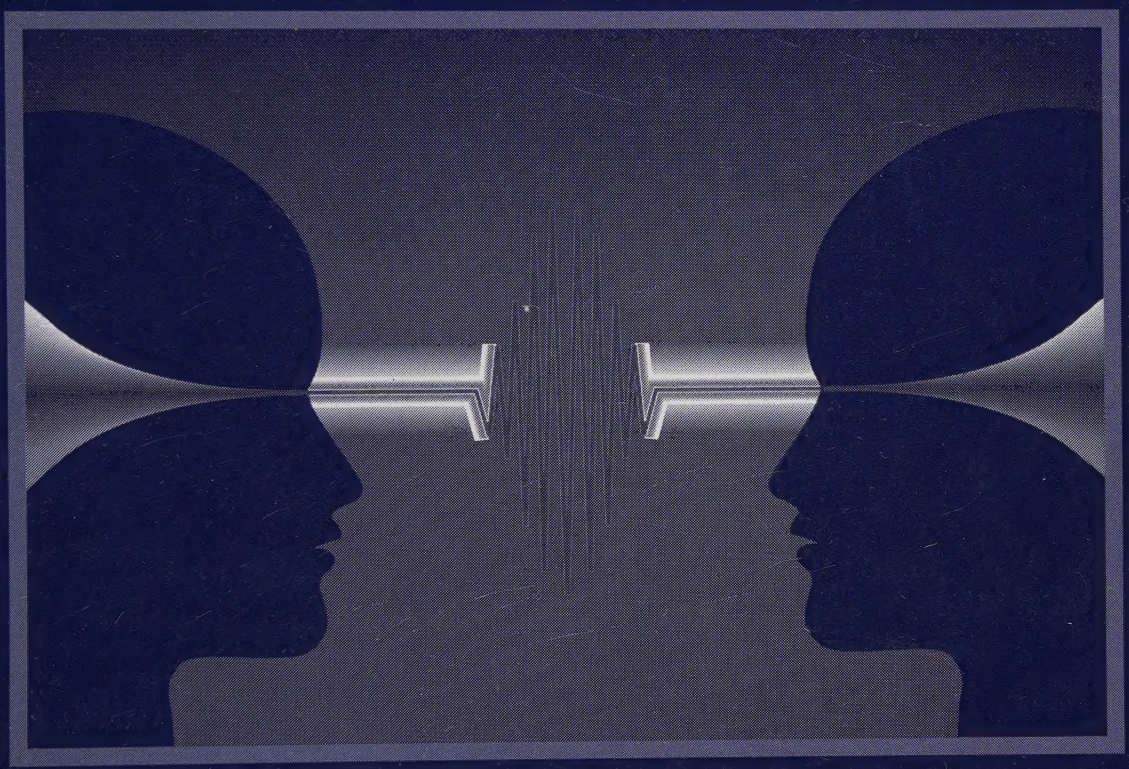
Study Guide to Accompany

EXPERIMENTAL PSYCHOLOGY

Understanding Psychological Research

FIFTH EDITION



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Chapter 1

Explanation in Scientific Psychology

IN OTHER WORDS

This chapter is concerned with what scientific psychology is about, and how it goes about it. The goal of scientific psychology is to explain why people think and act as they do.

We hold beliefs about things for a variety of nonscientific reasons. We might simply accept the word of a higher **authority**. We may **tenaciously** continue to believe something despite evidence to the contrary. We are more likely to accept explanations that sound reasonable ***a priori.*** Sometimes beliefs come in conflict with each other, and if we restrict ourselves to nonscientific methods of fixing beliefs, we have no reasonable means of resolving the conflict.

Unlike these unscientific methods, The scientific method of establishing belief is empirical, that is, it is based on systematic, repeatable observations. Because the observations are repeatable, the scientific method is said to be self-correcting. Nonetheless, even using the scientific method, scientists are **skeptical** in that they have adopted a philosophical belief that the truth of all knowledge is questionable.

Psychologists use a variety of procedures to gather their empirical observations. They may use the procedure of **naturalistic observation**, systematically observing phenomena, usually in a natural environment, and **describing** their observations. They may use the **correlational** procedure by paying attention to a relatively small number of factors, and determine which factors are related to each other. The correlational procedure allows the scientist make **predictions**. When psychologists make observations in a carefully controlled environment, in which some feature is deliberately manipulated, they are using the

experimental procedure, which allows an **explanation** of the phenomenon under study, i.e., a specification of the conditions under which the phenomenon will occur. A **quasi-experimental** procedure is used when nature, rather than a psychologist, is responsible for the manipulation. Conclusions from quasi-experimental procedures are not as strong as those from experimental research.

No one experiment will offer a complete explanation of a phenomenon. Better explanations come from many experiments. **Theories** help to tie the results of many experiments together, that is, they **organize** data. Theories also guide future research by allowing **predictions** to be made of what observations could be made if the theory were true. Theories are formed **inductively**, reasoning from a set of data to arrive at a set of statements that account for these data. The theory is tested by **deductively** predicting new data. Any number of theories might be offered to account for a set of data. One theory is considered better than another if it is simpler, requiring fewer statements to account for the data. Such a theory is said to be **parsimonious**. Parsimony is often achieved through the use of **intervening variables**, abstract concepts that link observable environmental and behavioral variables. Another criterion of a good theory is **precision**. The more precise a theory is, the more exact are the predictions that can be made from it. Finally, although no theory can be proven absolutely true, good theories are **testable**; they can be proven false.

Research in science is often divided into two categories - basic and applied. **Basic research** is conducted to establish a large data base and good theories for future reference. Basic research is not generally conducted to solve a specific problem, but rather to provide additional knowledge about a set of events or processes. **Applied research**, on the other hand, is directed explicitly at solving a particular problem in a real world setting. Applied researchers use knowledge gained from basic research in their work, although the time lag between the original observations in basic research and the eventual application of this knowledge might be quite long.

KEYWORD MATCHING

1.

_____what the following have to do with
_____*a priori* method
_____method of authority
_____method of tenacity

A. "Experimentation is best because the professor said so."
B. believing a reasonable proposition without examination.
C. is self-correcting, and based on experience
D. maintaining a stereotype despite evidence to the contrary
E. methods of developing beliefs
F. procedures under which scientific observations are made.

2.

_____what the following have to do with
_____correlation
_____empirical
_____experimentation
_____observation
_____quasi-experimentation

A. based on experience
B. definition
C. description
D. explanation
E. nature performs the manipulation
F. prediction
G. ways of developing scientific theories
H. ways of making scientific observations
I. ways of thinking logically

3.

_____what the following have to do with
_____parsimony
_____precision
_____testability

A. being sure that a theory can be proven false.
B. being sure that a theory can be proven true
C. characteristics of a good theory
D. exactness of predictions
E. the fewest number of propositions necessary
F. the greatest number of intervening variables
G. the number of predictions
H. ways of thinking logically

4.

____what the following have to do with
____deduction
____induction

A. falsifying a theory
B. making predictions from a theory
C. the relation between data and theory
D. theory development from a collection of facts

5.

____what the following have to do with
____applied research
____basic research

A. establishes a reservoir of data and theoretical explanations.
B. finding the answer to an applied problem in the real world
C. reasons for doing research

6.

____organization
____explanation
____scientific method
____social loafing

A. one of the purposes of a theory
B. specifying the conditions under which a phenomenon will occur
C. a method of fixing belief that is self-correcting and empirical
D. studied by Bibb Latané

PROGRAMMED REVIEW

1. The phenomenon that people work less hard in groups than alone is called _____ _____.
2. According to the American philosopher Charles Sanders Pierce, the simplest way of fixing belief is the method of _____.
3. The method of fixing beliefs is which one refuses to alter the acquired knowledge despite evident to the contrary is known as the method of _____.
4. In the _____ _____ method of fixing beliefs, propositions that appear reasonable are believed.
5. In scientific methods of fixing beliefs, beliefs are fixed on the basis of _____ _____.
6. Scientific psychology is characterized as being _____ and _____-correcting.

7. The psychological analysis of thoughts and behaviors involves _____, _____, and _____
8. In scientific psychology, observational research procedures correspond to the analytic activity of _____.
9. The correlational research techniques correspond to the analytic activity of _____.
10. In order to explain a given phenomenon, psychologists must use _____.
11. A type of research technique that used natural manipulations. rather than ones imposed by the researcher is the _____.
12. Two of the most important elements shared by all approached to science are _____ and _____.
13. In the inductive approach to science, reasoning proceeds from particular _____ to a general _____. The opposite occurs in the _____ approach to science.
14. The _____ scientist believes that general explanatory principles will emerge once enough data have been collected.
15. According to the _____ approach to theories, data are useful only in the evaluation of a theoretical explanation.
16. According to Popper, a philosopher of science, good theories must be capable of being _____ by data.
17. One function of a theory is to provide a framework for _____ existing data.
18. Theories may be used to generate _____ for situations where no data have yet been obtained.
19. A good theory will make very _____ predictions that allow the theory to be rigorously tested.
20. The two functions of a theory knows as organization and prediction are sometimes called _____ and _____ respectively.
21. _____ variables are manipulated by the experimenter. while _____ variables are observed by the experimenter.

22. Abstract constructs that like independent variables to dependent variables are known as _____ variables.

23. In evaluating theories, the criterion of _____ holds that the fewer the concepts a theory need to explain various phenomena, the better the theory.

24. Theories having mathematical formulations are said to have greater _____ than those using only verbal statements.

25. A theory that cannot be _____ can never be disproved.

26. Two of the purposes of science, namely to offer glimpses of reality and to provide practical knowledge, are referred to as _____ research and _____ research, respectively.

27. Psychologists try to understand the underlying _____ that lead to behavior rather than merely the physical situations that produce behaviors.

EXPERIMENTAL PROJECT

Make a list of about 10 statements that might be either true or false such as "cigarette smoking causes cancer," or "children of alcoholics are more likely to have psychiatric disorders than children of non-alcoholic parents." Ask several people how likely each of these statements is to be true, and why they believe so. Attempt to categorize their answers into one of the methods of belief fixation mentioned in the text. Do all of the answers fit this classification? Is there any relation between the strength of the belief, or whether the statement is believed to be true or false and the method by which the belief was fixed?

EXPERIMENTAL DILEMMA

Two researchers are studying the effects of marijuana on personal motivation. Both experimenters believe that chronic marijuana use is associated with a decline in motivation level, but they have different ways of studying the problem. Researcher A hypothesizes that "Grade point average decreases logarithmically with the number of marijuana cigarettes smoked per week." Researcher B's hypothesis is that "People who smoke marijuana have less drive to succeed than people who do not smoke marijuana." Which researcher has the better research hypothesis? Why? Is it possible to collect data to help answer this question? If so, how might this be done? If not, what would prevent this data from being collected and/or useful?

MULTIPLE CHOICE QUESTIONS

1. The goal of scientific psychology is to
   a. control peoples' behavior.
   b. understand why people think and act as they do.
   c. understand the relation between the mind and the body.
   d. explain abnormal behavior.

2. The simplest way of fixing beliefs is
   a. the *a priori* method.
   b. the method of authority.
   c. the method of tenacity.
   d. the scientific method.

3. After listening to a lecture by an astronaut who conducted experiments aboard the space shuttle, you now believe that plants can germinate in space. This belief was fixed by the
   a. the *a priori* method.
   b. the method of authority.
   c. the method of tenacity.
   d. the scientific method.

4. Your roommate asks whether you believe that sunbathing can increase one's chances of getting skin cancer. You reply that of course it can because "baking in the sun is bound to be harmful to skin tissue." This belief was probably fixed by the
   a. the *a priori* method.
   b. the method of authority.
   c. the method of tenacity.
   d. the scientific method.

5. Fixing a belief *a priori* refers to
   a. appealing to higher authorities,
   b. believing views that seem reasonable.
   c. believing opinions based on systematic observation.
   d. believing only facts and not unsupported opinions.

6. A disadvantage of fixing beliefs by the method of authority or *a priori* is that
   a. neither method involves systematic observation.
   b. neither method offers a way of deciding which of two conflicting beliefs is superior.
   c. neither method results in beliefs that are precise or testable.
   d. both a and b.

7. The scientific method is the preferred technique for satisfying curiosity because it
   a. relies on systematic observation.
   b. is self-correcting,
   c. provides an empirical basis for fixing belief.
   d. all of the above.

8. Which of the following is **not** one of the major classes of research techniques used in scientific psychology?
   a. correlation
   b. experimentation
   c. induction
   d. observation

9. A basketball coach keeps records on her players and determines that players who score more points tend to have higher grade point averages (GPA). The next year she selects her starting team members based solely on their GPAs. This decision is an example of using a(n) _____ to _____.
   a. correlation; predict behavior
   b. observation; predict behavior
   c. correlation; explain behavior
   d. observation; explain behavior

10. The difference between an experiment and a quasi-experiment is that the quasi-experiment
    a. produces data than con not be analyzed using statistical techniques.
    b. involves natural manipulations rather than ones imposed by the researcher.
    c. is conducted by a nonscientist.
    d. involves animal rather than human subjects.

11. The _____ scientist emphasizes data, and the _____ scientist emphasizes theory.
    a. deductive; empirical
    b. deductive; inductive´
    c. empirical; deductive
    d. empirical; inductive
    e. inductive; deductive
    f. inductive; empirical

12. The inductive scientist
    a. conducts research in order to gain support for a particular theoretical view.
    b. believes that organized patterns of important empirical relations will emerge once enough data are collected.
    c. is not concerned with empirical observation.
    d. none of the above

13. The deductive scientist
    a. conducts research in order to test the predictions of a particular theoretical view.
    b. believes that organized patterns will emerge once enough data are collected.
    c. is concerned primarily with empirical observation.
    d. none of the above

14. Which of the following is true concerning inductive and deductive scientists?
    a. Inductive scientists are more important because they provide basis data upon which to build theories.
    b. Deductive scientists are more important because they try to bring order out of the mass of data collected by empiricists.
    c. Most psychologists take either a purely inductive or purely deductive position.
    d. none of the above

15. According to the falsifiability view of theories proposed by the philosopher of science, Popper, _____ in evaluating a theory.
    a. negative evidence is more important than positive evidence
    b. positive evidence is more important than negative evidence
    c. replication of theories is most important
    d. proving the unreliability of the theory is most important

16. One key aspect of the falsifiability view of theories is that falsifiability depends upon
    a. fabricating data.
    b. unreliable data.
    c. empirical observations.
    d. theoretical inductions.

17. Theories
    a. serve to organize existing data.
    b. generate predictions for situations where no data have yet been collected.
    c. can never be proven to be true.
    d. all of the above.

18. Theories that are stated in terms of mathematical formulations are said to be more _____ than verbal theories.
    a. correct
    b. parsimonious
    c. precise
    d. provable

19. If a theory is not _____ is can never be disproven.
    a. mathematical
    b. parsimonious
    c. precise
    d. testable

20. Which of the following statements is true?
    a. Data that are partially consistent with a theory can cause the theory to be modified.
    b. Data that are inconsistent with a theory can lead to the rejection of the theory.
    c. Data that are consistent with a theory can never prove the theory.
    d. All of the above are true.

21. A scientist theorizes that if all males were removed form society, the incidence of violent crime would decrease by at least 80%. The major problem with this hypothesis is that it is not
    a. parsimonious
    b. precise
    c. reliable
    d. testable

22. If a theory does not have the potential to be disproved, then
    a. it is said to be unparsimonious.
    b. it is said to be testable.
    c. it is scientifically useless.
    d. none of the above

23. A major problem in trying to use current basic research to solve real world problems is that
    a. basic research can rarely be applied to such problems.
    b. most real world problems are unrelated to the problems studied by basic researchers.
    c. it is difficult to tell what basic research being done today will have an eventual impact on real world problems.
    d. most of the "facts" uncovered by basic research eventually are found to be wrong.

24. The fact that the relationship between basic psychological research and pressing social issues is not immediately obvious
    a. suggests that psychology has little to offer in the way of improving society.
    b. does not mean that no relationship actually exists.
    c. means that federal funding should be withheld from psychological research.
    d. suggests that psychologists are studying the wrong problems.

25. Psychologists
    a. are more interested in the physical situations and environments that produce behavior than in the processes underlying these behaviors.
    b. are interested in neither the physical situations nor the underlying processes that produce behavior.
    c. are more interested in the processes underlying behavior than in the physical situations in this the behavior occurs.
    d. none of the above.

TRUE-FALSE QUESTIONS

____ 1. The method of authority involves taking someone else's word on faith.

____ 2. Religious beliefs are generally formed by the method of tenacity.

____ 3. An advantage of the scientific method over other methods of fixing beliefs is that the scientific method offers a means of determining the "superiority" of one belief over another.

____ 4. The ultimate goal of psychologists is to predict behavior.

____ 5. The analytic activity of prediction corresponds to the research technique of experimentation.

____ 6. In a quasi-experiment, the investigator must necessarily employ nonhuman subjects due to the ethical involved in this type of research.

____ 7. Quasi-experiments do not allow one to draw conclusions as firm as those drawn from true experiments.

____ 8. Data are empirical observations.

____ 9. All approaches to science involve data and theory.

____ 10. According to the inductive approach to science, general explanations are arrived at from a set of theoretical statements that can then be tested against data.

____ 11. Theories induced from empirical data are tentative due to the limited scope of our data.

____ 12. Deductive approaches to science emphasize the primacy, or primary role of theory.

____ 13. One function of a scientific theory is to allow scientists to generate predictions for situations where no data have yet been obtained.

____ 14. Verbal theories are generally considered useless in psychology.

____ 15. Explanations involving intervening variables are more efficient than explanations that do not involve them, because intervening variables require fewer relations to be explained.

____ 16. Many correct predictions made by a theory can help to prove the theory to be correct.

____ 17. A theory can never be proved.

____ 18. If two theories can each account for the same data, but Theory A uses 10 statements while Theory B requires 15, then Theory B is better than A.

____ 19. The criterion of parsimony is most concerned with the number of statements needed to account for a set of findings.

____ 20. A theory can be precise without being testable.

____ 21. Basic research generally follows from the results of applied research.

____ 22. According to the text, the inability to predict what basic research being done today will ultimately have an impact on society, means that we should stop doing basic research.

_____ 23. Basic researchers generally assume that the same mental processes may occur in different physical situations.

_____ 24. Establishing similar physical situations in which to observe behavior guarantees similarity in the mental processes underlying the behavior.

ESSAY QUESTIONS

1. What are four methods for fixing belief? Which of these methods is superior to the others? Why?
2. Compare and contrast the deductive and inductive approaches to science. Can either be said to be better than the other? Why, or why not?
3. Define an intervening variable. Give three examples, and show how one of these might be useful in a theory.
4. What is meant by basic and applied research? Are the two related or separate enterprises?
5. What criteria may be used to evaluate theories? Which of these is the most crucial and why?

Chapter 2

Research Techniques: Observation and Correlation

IN OTHER WORDS

This chapter deals with two pre-experimental research techniques, observation and correlation. Observational research consists of looking at the world and describing what is seen. Correlational research attempts to discover how two or more variables are related. Each of these techniques are typical of and useful in the early stages of the exploration of a topic, and in studying topics where experimentation is either impractical or unethical.

Observational research conducted in real world settings is often called **naturalistic observation**. Naturalistic observation is a favorite technique of **ethologists**, scientists who study animal behavior as it occurs in nature. Since so much can happen in a natural setting, the researcher must restrict the particular events that are studied in order to make the research manageable. For this purpose, it is useful to construct an **ethogram**, a catalog of behaviors frequently exhibited by the animal under investigation.

When animals and people are observed, their behavior is likely to be different from what it would have been if they had not been under observation. This phenomenon is called **reactivity**, and is of particular concern in observational research. Ethologists and other observers often go to great lengths to minimize this problem. One way to reduce reactivity is to disguise the observer or the apparatus, and thereby make **unobtrusive observations**. Another approach is to observe the behavior indirectly, by noting the effects that the behavior has had on the environment, and thereby collect **unobtrusive measures** of the behavior of interest.

Other types of observational research may be somewhat more reactive, and include **participant observation**, **surveys**, and **case studies**. Since these techniques are more reactive, the results of such research should be interpreted cautiously.

The results of observational research consist of descriptions of the phenomena under investigation. It is sometimes difficult to describe what was observed objectively. A common pitfall is **anthropomorphizing**, or attributing human characteristics to animals under study. But even when our descriptions are objective, we are unable to assess relationships among the events.

The correlational approach is a stronger research technique than observation because it allows the researcher to specify the strength and direction of the relationship between two or more **variables** (things that can be measured or manipulated). The **correlation coefficient** is a statistic that describes relationships. The **Pearson *r*** is the most familiar correlation coefficient, and it can range in value from -1.0 and +1.0. If two variable are not related at all, *r* will equal 0.0. If *r* is positive in sign, we have a **positive correlation**: increases in one variable tend to be associated with increases in another variable. If *r* is negative, we have a **negative correlation**; the two variables are inversely related and increases in one variable are associated with decreases in the other. The further away that *r* is from 0.0, the stronger the relationship.

We must be careful in collecting the data in correlational research. It is important to have an adequate sample that includes a full range of both variables of interest. If one of the variables has a **restricted range** in the sample, the resulting value of the correlation coefficient will be low, even if the two variables are strongly related in the general population.

The results of correlational are useful for making predictions. If we know that height and weight are positively correlated, we can predict that a person who is taller than average will probably weigh more than most people. But interpretation of correlational research is limited because we can't specify the **cause** of the relationship. Is a person tall because he is heavy?, heavy because is tall?, or are both his height and weight determined by other (unmeasured) variables that are **confounded** with both height and weight? Variations of the correlational approach, such as the **cross-lagged correlational procedure**, have been devised to attempt to determine causality in correlational research.

KEYWORD MATCHING

1.

____what the following have to do with
____anthropomorphizing
____reactivity
____inability to assess relationships

A. limitations with correlational technique
B. limitations with observational technique
C. attributing human characteristics to animals
D. only descriptive data are available
E. restricting the range of behavior to be observed
F. the act of observing modifies the behavior under observation

2.

____what the following have in common
____case study
____deviant case analysis
____survey
____participant observation

A. variations of correlational technique
B. variations of observational technique
C. intensive investigation of a single subject
D. intensive investigation of a pair of similar subjects that have different outcomes
E. many subjects provide data to a set of questions
F. researcher plays active role in lives of subjects

3.

____what the following have in common
____participant observation
____unobtrusive measures
____unobtrusive observations

A. ways of delimiting observations
B. ways of reducing confounding
C. ways of reducing reactivity
D. covertly observing behavior
E. observing physical effects of behavior
F. observing while taking part in the lives of the subjects

4.

____strong positive relationship
____weak positive relationship
____strong negative relationship
____weak negative relationship

A. *r* is just less than 0.0
B. *r* is just more than -1.0
C. *r* is just more than 0.0
D. *r* is just less than 1.0
E. *r* is equal to 0.0

5.

____what the following have in common
____restriction of range
____inability to attribute causality

A. problems in interpreting correlational research
B. problems in interpreting observational research
C. *r* will be low if there is a small difference between the lowest and highest measure of a variable
D. *r* will be low if there is a large difference between the lowest and highest measure of a variable
E. the relationship between two variables may be mediated

6.

____cross-lagged-panel correlation
____ethnogram
____ethologist
____variable

A. scientist interested in animal behavior as it occurs in the real world
B. list of behaviors that can help to delimit naturalistic observations
C. thing that can be measured or manipulated
D. procedure that computes values of *r* across time in order to provide some evidence of causality

PROGRAMMED REVIEW

1. The only intellectual enterprise that builds cumulatively is _____.
2. The process of recording facts about naturally occurring phenomena is called _____ observation.
3. The research procedure in which detailed information is gathered about a single individual is known as a _____ _____.
4. A _____ involves collecting data from a number of individuals.
5. One problem facing a researcher using naturalistic observation has to do with delimiting the choice of which _____ to observe.
6. Case studies and surveys are both used to help make predictions about a person's behavior; as such, they are examples of the _____ technique.

7. A(n) _____ is a relatively complete inventory of the specific behaviors performed by one species of animal.
8. Two general ways to guard against the possibility of participants' reactions ruining our observations are to make unobtrusive _____ or take unobtrusive _____.
9. _____ _____ is when the observer is actively involved with the humans or animals that he or she is studying.
10. Unobtrusive measures generally involve making (direct/indirect) _____ observations of behavior.
11. A(n) _____ study is an intensive investigation of one example of a phenomenon.
12. A study of two similar cases that differ in their outcomes is an example of a procedure known as a _____-_____ analysis.
13. The primary problem unique to naturalistic observation is that it provides data that are primarily _____ in nature.
14. Attributing human characteristics to animals is referred to as _____.
15. Almost all correlation coefficients range between the values of _____ and _____.
16. A positive correlation occurs when one variable increases as the other variable (increases/decreases) _____.
17. A negative correlation occurs when one variable increases as the other variable (increases/decreases) _____.
18. As the strength of a relationship between two variables becomes greater, the absolute value of the correlation coefficient (increases/decreases) _____.
19. If we know what the correlation is between two variables, then we can _____ what the value of one variable will be if we know the value of the other.
20. The existence of a correlation between two variables implies nothing about the existence of a(n) _____ relationship between them.

21. _____ is said to occur when another factor varies along with the factor of interest.

22. Eysenk and Eaves (1981) argued that the correlation between cigarette smoking and lung cancer was mediated by _____ _____ in humans.

23. When one variable has a restricted range of measurement, the value of the correlation coefficient will be (low/high) _____.

24. The appropriate use of the Pearson *r* requires that the relationship between the two variables be _____.

25. The explanatory power of correlational research may be enhanced by examining the _____ among several different correlations.

26. The cross-lagged-panel correlation procedure is used to study the manner in which patterns of correlation change over _____.

27. One drawback of the cross-lagged-panel correlation procedure is that it may be very _____ _____ to employ.

EXPERIMENTAL PROJECT

Some psychologists have suggested that there may be a relationship between birth order and intelligence, with first-born children being more intelligent than their siblings. In fact, it has been shown that intelligence test scores decline steadily with birth order. You can examine this hypothesis in the following way. Obtain the number of older siblings that a person has, and let this be the *X* score. then let that person's grade point average be his or her *Y* score. (We are, of course, making the assumption that grade point average is somehow related to intelligence.) Obtain these measures from several (about 25) people. Correlate the scores using the Pearson correlation formula found in Appendix B of your text. If the hypothesis is correct, then you should find a negative correlation, with grade point average decreasing as the number of older siblings increases. Do your results support the birth order hypothesis? If not, what reason(s) can you offer for the discrepancy? What are the implications of your findings.

EXPERIMENTAL DILEMMA

1. An industrial psychologist interested in the effects of a work training program on job performance reported the following study. Fifty garment factory workers were

given on the job training in a program that lasted either one or two weeks. Afterward their performance levels (measured in terms of the number of work pieces completed in one day) were correlated with the number of weeks spent in training. The correlation coefficient obtained between these two measures was -.02. From this result the researcher concluded that the training program was ineffective and should be abandoned. If you were a top management executive, would you comply with the researcher's recommendation? Why or why not?

2. A social psychologist interested in the effects of unemployment on alcohol abuse mailed questionnaires to the homes of workers who had been laid off from a local automobile plant. The questionnaires were mailed at various time intervals as the workers were asked to anonymously fill out and return the questionnaires. The questionnaires contained items designed to provide information as to the amount of alcohol consumed daily before and after the layoffs occurred. Fifty percent of the sample completed and returned the questionnaires sent out during the course of the study. For those individuals who returned the questionnaires, the researcher found a positive correlation between alcohol consumption and length of unemployment of +.87, The is, more alcohol was consumed as the period of unemployment progressed. In his report the researcher stated that "the conditions of unemployment produce a tendency for people to increase their alcohol intake." If you were the journal editor in charge of deciding whether or not to publish this manuscript, what would your decision be?

MULTIPLE CHOICE QUESTIONS

1. Ethology
   a. is the study of animals.
   b. sometimes involves observations in natural contexts.
   c. is restricted to laboratory settings.
   d. both a and b
2. Which of the following is least likely to be included in an ethogram?
   a. the level of physiological reaction to experimentally induce shock
   b. the amount of time spent eating during daylight hours
   c. the number of grooming behaviors observed during a given period
   d. the frequency of mating

3. Which of the following is likely to result in participant reactivity?
   a. placing a video camera in an office to measure productivity
   b. studying the number of telephone calls made from an office be examining the telephone bill.
   c. examining the graffiti on restroom walls
   d. examining the nature of refuse that people discard
4. Participant observation involves
   a. asking the participants of an event to recall the event.
   b. the observer participating in the lives of the subjects being observed.
   c. unobtrusive observations of the participants of an event.
   d. surveys of people who participate in unique events.
5. One example of an unobtrusive measure is
   a. quietly recording a person's behavior while observing them across a room.
   b. studying fashion trends by examining photos of fashion models from magazines published at different times.
   c. comparing the effects of two unstructured study methods on students' performance on reading tests.
   d. studying a receptionist's appointment book to see how many people fail to show up for their dentist appointments
6. The advantage of the case study method of observation is that
   a. the researcher selects observations and questions in an unbiased manner.
   b. firm inferences can be made about the antecedent conditions leading to the observed effects.
   c. obtained observations are easily reproduced.
   d. none of the above
7. An advantage of naturalistic observation is that
   a. it allows for a good deal of experimental control.
   b. it allows for easy replication.
   c. it helps the researcher to define a problem area and to begin to raise interesting questions.
   d. it is primarily descriptive.

8. Each of the following is true of naturalistic observation **except**
   a. it is primarily descriptive in nature.
   b. it involves the use of many subjects.
   c. the data are often not easily reproduces by other researchers.
   d. it does not allow one to manipulate the antecedent conditions.

9. The use of correlational techniques permits the researcher to
   a. make predictions on the basis of obtained correlations.
   b. understand why two variables are related.
   c. manipulate the effect of one variable on another.
   d. infer a lack of causation.

10. The correlational approach
    a. usually involves *ex post facto* assessments.
    b. specifies the degree of relationship between two variables.
    c. does not allow for causal inference.
    d. all of the above

11. Which of the following correlation coefficients reflects the strongest relationship between two variables?
    a. -.85
    b. +.75
    c. 0.0
    d. -.50

12. Which of the following reflects a positive correlation?
    a. The ratio of head size to height decreases with age.
    b. Yearly income increases as education level is increased.
    c. Men own more cars that women.
    d. Amount of exercise is inversely related to the incidence of heart attacks.

13. The appropriate use of a Pearson correlation coefficient requires that
    a. the relationship between the two variables must be linear.
    b. the two measure must be on the same scale.
    c. the two variables must be similar.
    d. the two variables must be highly related.

14. Which of the following statements is **not** true?
    a. We can never rule out the possible effects of mediating variables in correlational research.
    b. As a correlation coefficient increases, we can be more sure that a causal relationship exists between the two variables.
    c. A Pearson product-moment correlation coefficient provides information as to the magnitude of the relationship between the two variables.
    d. It is possible to correlate two variables that have different scales of measurement.

15. Experiments differ from correlational studies in that
    a. experiments allow for stronger inferences about the relationship between variables.
    b. irrelevant variables are held constant in experiments,
    c. variables are controlled by the researcher in experiments.
    d. all of the above

16. The sign (positive or negative) of a correlation coefficient indicates the _____ of relationship between the two variables.
    a. force
    b. direction
    c. degree
    d. linearity

17. The cross-lagged-panel correlational procedure is used to
    a. examine multiple correlations.
    b. partial out the effects of irrelevant variables.
    c. examine patterns of correlations over time.
    d. examine the results when variables are crossed with one another.

TRUE-FALSE QUESTIONS

_____ 1. Science is the only intellectual enterprise that does not grow cumulatively.

_____ 2. The experimental method allows a researcher to make inferences about causation, or what events lead to other events.

_____ 3. In naturalistic observations, the participants' reactions to being observed can threaten the external validity of the observations.

_____ 4. The case study method is an example of participant observation.

_____ 5. Unobtrusive measures are usually indirect observations of behavior.

_____ 6. A detailed account of one family's reaction to the terminal illness of one of its members is an example of a case study.

_____ 7. Deviant-case analyses involve the investigation of highly unusual behavior patterns.

_____ 8. Deviant-case analyses complicate the problem of inference in observational research.

_____ 9. Survey research involves reactive observations.

_____ 10. Naturalistic observation is primarily descriptive.

_____ 11. Naturalistic observation often leads to the development of more advanced theories.

_____ 12. Replication is a problem in observational research.

_____ 13. Anthropomorphizing is the attribution of animal-like characteristics to humans.

_____ 14. Correlation is a more powerful research technique then observation.

_____ 15. Correlation coefficients typically vary between -1.0 and 0.0

_____ 16. Perfect correlations are frequently obtained in psychological research.

_____ 17. The correlation between the number of cigarettes smoked and the likelihood of getting lung cancer is positive in that an increase in one variable is accompanied by a similar increase in the other.

_____ 18. It is rare to find two variables that are highly correlated but not causally related.

_____ 19. Causation my not be inferred from correlation.

_____ 20. Mediation is more of a problem in experimental research than in correlational studies.

_____ 21. One can always propose a third mediating factor that might be responsible for the correlation between two variables.

_____ 22. Low correlations generally imply a lack of causation.

_____ 23. Causation may be inferred if the range of one of the variables is restricted.

____ 24. The cross-lagged-panel correlation procedure involved repeated observations taken across a time interval.

ESSAY QUESTIONS

1. Discuss the advantages and disadvantages of naturalistic observation.

2. Why can we never infer causation from correlation? What are some of the procedures that may be used to increase the explanatory power of correlational research?

3. What is meant by *confounding*? Is confounding limited to correlational studies? Cite a real-world example of confounding that might result from only looking at two variables.

Chapter 3

Research Techniques:

Experiments

IN OTHER WORDS

In a simple psychological **experiment**, an environmental variable is carefully manipulated by the researcher in order to determine its effects on behavior. Behavior is observed under two or more **levels** of the **independent variable** to provide a comparison. The **dependent variable** is the aspect of behavior that is measured to determine the effect of this manipulation. Since behavior can be affected by many factors in the environment, the influence of other potential independent variables, called **control variables**, is minimized, usually by holding them constant.

Simple experiments may be extended to include more than one independent variable. This not only affords greater economy of research but, more important, it allows the researcher to identify and study **interactions**, which occur when the behavioral effects of one independent variable depend on the level of another independent variable. For example, in a **synergistic** interaction, the effects of two independent variables acting together is greater than the sum of the two effects when they act alone. It is also useful to include more than one dependent variable. Scientific experiments generally are conducted to test theories and to extend and set limits on the results of previous research; the results of **what-if experiments** are rarely useful.

Both the independent and the dependent variables must be chosen carefully for a successful experiment. The independent variable, obviously, must influence behavior. Moreover, the difference between the control and the experimental levels

of the independent variable must be large enough to produce a behavioral effect. The dependent variable should be stable for a given subject and a given set of conditions, and it should be sensitive to the different conditions in the experiment. **Floor effects** occur when the measures of the dependent variable remain low under all levels of the independent variable. The scores on a test that is much too hard do not reflect the amount of study or the ability of the student. **Ceiling effects** occur when the measures of the dependent variable are uniformly high, as would be obtained for a test that was much too easy.

Experiments are designed to provide clear comparisons of the behavioral effects of different levels of the independent variable. Extraneous variation must be minimized. In order to achieve this, the assignment of subjects to the various experimental conditions is an important consideration. In a **between-subjects design**, each subject is tested in only one treatment condition, and the effect of the independent variable is determined by comparing subjects tested under one level with subjects tested under another level of the independent variable. This is generally a safe procedure, provided that the groups of subjects are equivalent. Researchers attempt to form equivalent groups through **randomization**, assigning subjects to the various treatment conditions randomly. This is a good procedure, if the number of subjects is large enough. Another way that is used to attempt to form equivalent groups of subjects is **matching**, identifying groups of similar subjects, and assigning one member of each group to each treatment condition. Matching is less highly regarded than randomization, because it is difficult to know the criteria on which to do the matching.

In **within-subjects designs**, each subject is tested under all treatment conditions. These designs are generally more efficient than between-subjects designs, but care must be taken to minimize confounding treatment levels with general practice and differential carryover effects. **Counterbalancing** refers to sequencing the treatments to minimize this confounding. When there is more than one independent variable, a **mixed design** may be used in which some independent variables are evaluated by between-subject comparisons, and other independent variables are evaluated by within-subject comparisons.

Regardless of which experimental design is used, there are certain threats to the validity of an experiment. These include **demand characteristics**, a type of reactivity, in which a subject's behavior is influenced by his or her knowledge that he or she is in an experiment. The **Hawthorne effect** is a classic example of demand characteristics. **Experimenter effects** refer to an influences on the subjects behavior produced by inadvertent actions of the experimenter. Automated testing can be used

to minimize experimenter effects, as can using **double-blind** procedures, in which neither the experimenter nor the subject knows which treatment condition is being tested.

Quasi-experiments are those which attempt to assess the effect of **subject variables** on behavior. Subject variables are those characteristics of subjects that they bring to an experiment, and that the experimenter cannot directly manipulate or control, such as gender or academic major. Quasi-experiments are inherently correlational in nature. Matching is often used to form groups that (hopefully) differ only in the level of the subject variable of interest. A problem in evaluating quasi-experiments is that of **regression artifacts**. When subjects are pretested for matching purposes in a quasi-experiment, it is often the case that low scorers in a more able group are matched with high scorers from a less able group. When retested during the experiment, it is likely to be the case that the retest scores will be closer to the original group means, a phenomenon called **regression to the mean**.

KEYWORD MATCHING

1.

_____ control variable
_____ dependent variable
_____ independent variable
_____ subject variable

A. a subject characteristic such as age or handedness
B. demand characteristic
C. what is held constant
D. what the experimenter manipulates
E. what the experimenter measures

2.

_____ ceiling effect
_____ demand characteristic
_____ experimenter effect
_____ floor effect
_____ interaction
_____ regression artifact

A. a form of reactivity
B. a particular danger when matched groups are used
C. all data are near the maximum value
D. all data are near the minimum value
E. can be minimized by automated testing
F. controlled by random sampling
G. the effect of one independent variable depends on the level of a second

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3.

_____ between-subjects design
_____ mixed design
_____ quasi experiment
_____ small-n design
_____ within-subject design

A. must involve more than one independent variable
B. one, or a few subjects observed many times
C. pits two theories that make opposite predictions against each other
D. subject characteristic serves as an independent variable
E. subject serves in all conditions
F. subject serves in only one condition

4.

_____ counterbalancing
_____ double-blind experiment
_____ matching
_____ randomization

A. a way to achieve equivalent groups by assigning similar people to different treatments
B. a way to achieve equivalent groups that does not involve a pretest.
C. a way to control demand characteristics
D. a way to control experimenter effects
E. sequencing of treatments in a within-subject design

5.

_____abscissa
_____baseline
_____level
_____ordinate

A. a control to compare against treatment effects
B. independent variables must have at least two of these
C. the X axis of a graph where the dependent variable is plotted
D. the X axis of a graph where the independent variable is plotted
E. the Y axis of a graph where the dependent variable is plotted
F. the Y axis of a graph where the independent variable is plotted

PROGRAMMED REVIEW

1. The basic elements of an experiment are the dependent and independent _____ used in the experiment.
2. In an experiment the behavior that is recorded by the experimenter is called the _____ variable, whereas the manipulation of the environment that is controlled by the experimenter is called the _____ variable.
3. The different ways that the experimenter manipulates the environment are called the _____ of the _____ variable.
4. In order to conduct an experiment. there must be at least _____ way(s) of manipulating the environment.
5. One of the main advantages of experimental research over nonexperimental research techniques is that an experiment allows better control of _____ that may affect the observed behavior.
6. In an ideal experiment only the _____ variable can cause the changes observed in the _____ variable.
7. Nonexperimental research techniques allow a researcher to make statements about _____ and _____. Experiments, in principle, lead to statements about _____.
8. Experiments are usually conducted to test theoretical predictions and to establish the range of experimental results. _____ experiments are unlikely to be productive.
9. An experiment designed to test two theories that make different predictions regarding the results of the experiment is called a(n) _____ experiment.
10. One problem with an exact replication of an experiment is that this kind of replication does not demonstrate the _____ of the results obtained.
11. An experiment that replicates and extends the original experiment can demonstrate the _____ of the results, and add to our scientific knowledge.
12. In an experiment on taste preference, a researcher varied the amount of sugar used in an iced tea mixture. The amount of sugar is called the _____ variable in this experiment.

13. An experimental result that shows that an independent variable does not control behavior is known as a(n) _____ result.

14. A researcher is likely to obtain null results if (s)he does not produce a strong manipulation of the _____ variable.

15. The experimenter records the _____ variable.

16. A good dependent variable is one that is _____.

17. When the dependent variable is limited to the upper range of the scale. this is known as a(n) _____ effect. When the dependent variable is limited to the lower range of the scale, this is known as a(n) _____ effect.

18. Variables that are held constant during an experiment are called _____ variables.

19. It is very important to control extraneous factors when the magnitude of effect produced by the independent variable is (small/large) _____.

20. Sources of extraneous variation can be controlled by holding them _____ and by _____ removing them.

21. It is (more/less) _____ efficient to conduct an experiment with four independent variables than to conduct four separate experiments.

22. Results that are shown to be valid across several situations are said to _____ across several independent variables.

23. When the effects produced by one independent variable are not the same at each level of another independent variable, this pattern of data is known as a(n) _____.

24. In the Martell and Willis (1993) study cited in the text, subjects' memory of the performance of a work group was measured. The two independent variables in this study were _____ and _____.

25. The results of experiments employing more than one dependent variable can be analyzed by using _____ statistical procedures.

26. The purpose of experimental design is to minimize _____ or _____ variation.

27. When only some of the subjects in the experiment are assigned to each level of an independent variable, this is know as a(n) _____-subjects design.

28. In a _____-subjects design, each subject is tested under each level of the independent variable.

29. When a _____-_____ design is used there is no possibility for one experimental treatment contaminating another experimental treatment.

30. When a between-subjects design is used the experimenter must ensure that the groups are equivalent at the (beginning/end) _____ of the experiment.

31. When subjects are first paired on the basis of ability (or some other measure) and then members of each pair are randomly assigned to different groups, this technique is known as _____.

32. A difficulty with the _____ technique in establishing equivalent groups is that we generally don't know all of the relevant factors to take into account.

33. Subjects are most often assigned to experimental conditions by the use of some _____ method.

34. An experimental design that used all possible treatment orders is known as a(n) _____ _____ design.

35. Complete counterbalancing becomes impractical as the number of possible _____ increases.

36. Counterbalanced designs (do/do not) eliminate order effects.

37. An experimental design in which some independent variables are manipulated as between-subject variables, while others are manipulated as within-subject variables, is known as a _____ design.

38. Most between-subject designs include some control _____, and most within-subject designs contain one or more control _____ to serve as _____ for comparisons.

39. The simplest type of control group is simple one that does not receive the levels of interest of the _____ variable.

40. The influence exerted by a subject's knowledge that (s)he is in an experiment is called a _____ characteristic.

41. The influence of demand characteristics reduce the _____ of the experimental findings.

42. A well-known example of a demand characteristic is the _____ effect.

43. If an experimenter accidentally influences the outcome of an experiment by providing slight clues as to his or her expectations, then this is known as a(n) _____ effect.

44. One of the best ways to eliminate the experimenter effect is to use the _____-_____ procedure, in which neither the subject nor the experimenter knows which experimental conditions the subject has been assigned to.

45. One way to eliminate experimenter effects is to have the experiment administered _____, so that the experimenter does not interact with the subjects until the experiment is completed.

46. If it is not possible or ethical to manipulate the independent variable in an experiment, the researcher may instead conduct a _____-_____.

47. Quasi-experiments use naturally occurring _____ variables such as age or gender of the subject.

48. One limitation of quasi-experiments is that the naturally occurring independent variable may include several important _____ variables.

49. One way to avoid confounding of subject variables is to use a _____ procedure when assigning subjects to groups.

50. A problem associated with matching subjects is that it may serve to (increase/decrease) _____ the size of the sample on which observations are made.

51. _____ is a form of interaction in which the combined effect of two independent variables is (less/greater) _____ that the sum of the two effects measured independently.

52. Matching procedures may introduce the problem of _____ artifacts.

53. In many test-retest experiments, subjects who make extreme scores (either high or low) on the first test will score (closer to/further from) _____ the mean on a subsequent test.

54. The aim of all research is to solve a _____.

55. Once an experimenter has identified a problem that (s)he wants to solve, the next step is to translate that problem into a _____ _____.

56. A hypothesis is a particular _____ that is often stated in the form: if A, then B.

57. _____ refers to selecting subjects from some population.

58. A _____ sampling technique ensures that every member of a population has an equal chance of being selected to serve in the study.

59. When random sampling is used, each selection of a subject is _____ of other selections.

60. Statistical analysis can tell a researcher which data are _____, but these analyses cannot tell the researcher which results are _____.

61. The mass of data that is collected in a experiment is usually condensed or summarized through the use of _____ statistics.

62. The most common descriptive statistics are the _____ and the _____ _____.

63. The vertical scale in a figure is called the _____ and the horizontal scale is known as the _____.

64. The _____ variable is plotted on the ordinate and the _____ variable is plotted on the abscissa.

EXPERIMENTAL PROJECT

Several researchers have shown that when people know they are in an experiment they will often behave quite differently than they would otherwise. These demand characteristics can be quite powerful. For example, Orne (1962) demonstrated that people will persist at performing quite boring and meaningless tasks if they think they are in an experiment. Orne gave his subjects the task of adding pairs of numbers from sheets with random numbers printed on them. After completing the additions, subjects were told to tear up the sheet of paper and start the next one. Even with such an obviously meaningless task, subjects persisted at the task for several hours. Subjects later reported that they had given meaning to the task by supposing that the experimenter must have had a good reason for doing the experiment.

In order to illustrate how much on an effect such demand characteristics can exert on behavior, you can conduct the following simple demonstration. You will need to recruit several volunteers. The task you are going to give your volunteers must be harmless, but also boring and meaningless. A good task might be to require

your volunteers to count up all of the last names in the telephone book that have two letters, all that have three letters, and so on. You might ask the volunteers to do this separately for each letter of the alphabet.

Half of your volunteers should be told that this is part of an experiment for your psychology class. Do not tell the volunteers in this group what the experiment is - just tell them that you are collecting data as part of a class project. The remaining volunteers should be given some cover story, such as they are helping you to win a bet with a friend, or that you were just curious and that you had already counted the names, but now you wanted to check on how accurate your count was.

Randomly assign your subjects to two groups. Test your volunteers individually by explaining the task to them, and telling them that you will check with them later.

You are going to measure how many minutes your volunteers will persist in this task before telling you that they want to stop (or telling you something to that effect!). Do not let any of your subjects continue for more than one hour. When your volunteers stop (or you stop them), it is your responsibility to explain fully to them the purpose of your project. Explain what demand characteristics are, why they are important considerations when conducting experiments, and that most people respond about the same way as your volunteer did.

Your data for this experiment will be the number of minutes people in both groups performed the task. If a person performed for one hour and then you stopped them, give that person a score of 60. Compute a mean for each group. Which group performed the longest? Did your volunteers say anything that gives you insight into demand characteristics? Did you have any problem with ceiling effects? Was your manipulation of the cover story you gave your volunteers effective? Could this demonstration be considered a true experiment? If yes, what were the independent, dependent, and control variables? If no, why was this not a true experiment?

REFERENCE

Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist, 17*, 776-783.

EXPERIMENTAL DILEMMAS

1. Male college students were recruited to participate in a motor learning experiment. The task being used required the subjects to throw a dart at a one inch diameter target mounted on a wall 10 feet from the subject. The researcher was interested in the effects of monetary incentives on learning this task. Subjects were given 10 practice throws before the experiment began. Then, subjects in both groups were promised $3.50 for participating in the experiment. In addition. subjects in the high-incentive group were told they would receive $.50 for every successful throw, while subjects in the low-incentive group were offered $.25 for each successful throw.

Subjects were assigned randomly to one of the two groups and all subjects were given 50 throws. The results showed that there was no statistically significant difference between the two groups in terms of the number of successful throws. The researcher concluded that monetary incentives have no effect on performance in this task.

Would you accept the researcher's conclusion? Why or why not? Is there any additional information that would allow you to answer this question more confidently? How could the design of the experiment be improved if you wanted to replicate and extend this study?

2. On the basis of scores obtained on a general reading skills test, a researcher selected twenty second graders to participate in a remedial reading program. The children were selected because they did not perform as well as their classmates in general reading skills, and it was hoped that the program would improve their reading ability. The program involved individual sessions with a special instructor three hours a week for six weeks. At the end of the period, the test was readministered to the students in the program. Scores were compared with those of children of similar ability from another grammar school in the area who took the test again at the same point in the school year as the children in the remedial program. The results showed no difference between scores for children who had participated in the remedial program and those who had not. Although the researcher wanted to conclude that the program had been ineffective, a reviewer argued that the results could have been due to regression artifacts. Do you agree with the reviewer? Why or why not?

MULTIPLE CHOICE QUESTIONS

1. In an experiment, the variable manipulated by the experimenter is the _____ variable, and the behavior recorded by the experimenter is the _____ variable.
   a. independent, dependent
   b. dependent, independent
   c. observed, control
   d. control, observed

2. In order to conduct a true experiment, there must be at least one dependent variable and
   a. one independent variable with at least one level.
   b. one independent variable with at least two levels.
   c. two independent variables each with at least one level.
   d. two independent variables each with at least two levels.

3. All of the following are advantages of experiments over nonexperimental research techniques **except**
   a. experiments allow better control of extraneous variation.
   b. experiments are more economical in terms of the time to conduct the research.
   c. scientists cannot misinterpret the results of an experiment.
   d. in principle, experiments permit statements about causation.

4. In principle, experiments are designed to allow scientists to make statements about
   a. correlation.
   b. relatedness.
   c. causation.
   d. contiguity.
   e. *a* and *b*

5. "What-if" experiments are inefficient because
   a. their findings are not of interest.
   b. a null result is not informative.
   c. they cannot tell us anything about real-life behavior.
   d. nothing can be gained from them.

6. Experiments are conducted in order to
   a. test theories.
   b. replicate and extend previous findings.
   c. just to see what happens.
   d. all of the above
   e. both *a* and *b*

7. Experiments that attempt to replicate and extend previous findings are important because
   a. such experiments demonstrate the generality of the findings.
   b. such experiments decrease the chances that the results will be misinterpreted.
   c. an experiment that has been replicated is more convincing than a single experiment.
   d. all of the above
   e. both *a* and *c*

8. Dependent variables are dependent on
   a. the experimental manipulations.
   b. the behavior of the subject.
   c. the experimental control conditions.
   d. the experimentally produced comparisons.

9. In an experiment, the variable that the experimenter manipulates in order to study its effect on the subjects' behavior is called the
   a. control variable.
   b. experimental variable.
   c. dependent variable.
   d. independent variable.

10. From a methodological point of view, a good dependent variable should be
    a. stable.
    b. related to the independent variable.
    c. of theoretical interest.
    d. easy to observe.
    e. both *b* and *d*

11. Floor and ceiling effects result from using
    a. an unreliable dependent variable.
    b. only one level of the independent variable.
    c. two very extreme levels of the independent variable.
    d. a restricted range of the dependent variable.

12. A control variable is
    a. a potential dependent variable that is held constant.
    b. a potential independent variable that is held constant.
    c. a dependent variable that is manipulated in a controlled fashion by the experimenter.
    d. an independent variable that is manipulated in a controlled fashion by the experimenter.

13. Which of the following is **not** an advantage of manipulating several independent variables within the same experiment, as compared to manipulating these variables in separate experiments?
    a. greater efficiency
    b. interaction effects may be observed
    c. results have greater generality
    d. results are easier to interpret

14. An interaction occurs when
    a. the effects of one independent variable are not the same at each level of a second independent variable.
    b. the effects of one level of an independent variable are not the same at other levels of that independent variable.
    c. the effects of an independent variable are not the same at each level of the dependent variable.
    d. the effects of a dependent variable are not the same at each level of the independent variable.

15. The nature of the interaction in the 1993 study by Martell and Willis was
    a. the kind of feedback (positive vs. negative) was more important than the kind of work behavior (effective vs. ineffective) remembered.
    b. effective work behavior was more likely to be remembered by subjects given positive feedback, and ineffective work behavior was more likely to be remembered by subjects given negative feedback.
    c. effective work behavior was more likely to be remembered by subjects given negative feedback, and ineffective work behavior was more likely to be remembered by subjects given positive feedback.
    d. people given negative feedback were more likely to engage in ineffective behavior than people give positive feedback.

16. In a simple between-subjects experimental design, each subject is given _____ level of the independent variable, while in a within-subjects design, each subject is given _____ level of the independent variable.
    a. one; one
    b. each; one
    c. one; each
    d. each; each

17. In experiments employing between-subjects designs, randomization and matching techniques are used in an attempt to
    a. prevent treatment carryover effects.
    b. ensure that the groups are equivalent at the start of the experiment.
    c. minimize experimenter effects.
    d. minimize demand characteristics.
    e. both *b* and *c*

18. In a within-subjects completely counterbalanced design
    a. order effects are eliminated.
    b. order effects can be evaluated.
    c. only a subset of all possible treatment orders are used.
    d. two dependent variables are employed.

19. In a completely counterbalanced experimental design
    a. each group of subject receives a different treatment.
    b. every subject receives every treatment.
    c. all possible treatment orders are used.
    d. the treatment orders are randomized.
    e. both *b* and *c*

20. Demand characteristics refer to the problem of
    a. subjects misinterpreting the experimenter's instructions.
    b. the influence of the expectations of the experimenter on the experimental results.
    c. the subjects' behavior being influenced by the fact that they are aware they are in an experiment.
    d. treatment carryover effects.
    e. both *b* and *c*

21. Quasi-experiments differ from true experiments in that quasi-experiments involve
    a. naturally occurring independent variables.
    b. naturally occurring dependent variables.
    c. using only animal subjects.
    d. greater demand characteristics.

22. Which of the following is a subject variable?
    a. eye color
    b. study time
    c. type of reading material
    d. shock amplitude

23. Which of the following is true concerning quasi-experimental designs?
    a. They are less powerful than observational studies.
    b. They often include subject variables.
    c. They involve careful manipulation of experimental variables.
    d. They are rarely used in psychological research.

24. Matching procedures
    a. are often used in quasi-experiments.
    b. are a way of avoiding confounding of subject variables.
    c. introduce the possibility of regression artifacts.
    d. all of the above

25. If a researcher wants to us a research design that employs subject variables. then that researcher will
    a. manipulate the subject variable while holding other factors constant,
    b. select subjects who have the chosen characteristics in some varying degree.
    c. select a behavior to measure that will not vary with the subject variable.
    d. both *b* and *c*

26. In designs that employ subject variables, matching refers to
    a. matching subjects on the subject variable.
    b. matching subjects in the behavioral task that is measured.
    c. matching subjects on the variables that may be confounded with the subject variable.
    d. matching subjects on variables that are known to be confounded with the behavioral task.

27. The phenomenon of regression to the mean implies that to two very tall parents have a child, then the child's adult height is most likely to be
    a. shorter than the mean of the parents height.
    b. taller than the mean of the parents height.
    c. close to the mean of the parent height.
    d. either *a* or *c*

28. Statistics tell us
    a. which data are important.
    b. which data are reliable.
    c. what conclusions are valid.
    d. what the treatment effects signify.

TRUE-FALSE QUESTIONS

_____ 1. In order to have a true experiment, there must be at least two levels of the dependent variable.

_____ 2. Experiments that test the predictions of two competing theories are called critical experiments.

_____ 3. The main objection to "what-if" experiments is that they do not allow the researcher to draw causal inferences.

_____ 4. An important criterion for a good dependent variable is stability.

_____ 5. An interactions occurs when the effect produced by one independent variable is not the same for all levels of another independent variable.

_____ 6. Whenever interaction effects are obtained, it does not make sense to consider separately the effects of each independent variable involved in the interaction.

_____ 7. In experiments using within-subjects designs, counterbalancing techniques are used to eliminate the effects of treatment order.

_____ 8. Randomization is often used to try to insure that the different groups used in a within-subject design are equivalent.

_____ 9. The control condition is an experiment that should provide a basis against which some variable of interest can be compared.

_____ 10. Demand characteristics are what psychologists call the influence of the subject's knowledge that an experiment is underway.

____ 11. In a quasi-experiment, the researcher has generally violated the ethical standards of research by manipulating subject variables.

____ 12. Matching is used to ensure that subjects do not differ at the end on an experiment.

____ 13. Subject variables are variables directly subject to the experimenter's manipulation.

____ 14. Matching procedures can lead to regression artifacts.

____ 15. Experiments are conducted to test hypotheses.

____ 16. The key difference between an hypothesis and a problem is that a hypothesis may be directly tested, whereas a problem is not testable.

ESSAY QUESTIONS

1. Define the three types of variables involved in an experiment. Outline an experiment and identify an example of each type of variable in the experiment.
2. What are null results? What are the reasons that an otherwise valid experiment could produce null results? Describe an experimental design that could yield null results, and an alternative design that would be likely to avoid the problem(s) responsible for producing the null results.
3. Distinguish between main effects and interactions. Give an example of each. How do interactions affect the interpretation of main effects?

Chapter 4

Ethics in Psychological Research

IN OTHER WORDS

A ethical researcher does everything in his or her power to **protect from harm** the physical and mental well being of research participants. The American Psychological Association publishes guidelines for ethical considerations in research.

Human research subjects (or an appropriate representative of the subject) should be required to give **informed consent** to participate in the research. This means that the research is explained to the person in sufficient detail so as to allow the person the make a reasonable judgment as to whether to participate. People should always be allowed to decline to participate, and be given the freedom to withdraw from the experiment at any time. Some research involves **deception** of the subjects to make the research less reactive; such research should only be conducted if the potential value of the research far outweighs the potential risks to the participants.

Subjects should be **debriefed** at the end of the study, which means that the researcher explains the general purposes of the research, and the nature of the manipulations used. The investigator must strive to remove any misconceptions that may have arisen as a result of participating in the study. All data collected in the experiment from individual participants should remain **confidential**, unless otherwise agreed. During the debriefing, and afterwards if necessary, the researcher should take care to **remove any harmful consequences** of an experimental treatment.

The use of animals as research subjects is controversial. Animals are often used to answer questions that would be impractical or impossible to answer with

human subjects, and also because they are interesting in their own right and part of the natural world. Animal-rights activists argue that the use of animals in research is ethically wrong because 1) animals feel pain and their lives can be destroyed, 2) causing such pain and loss of life is dehumanizing to the human researcher, and 3) the use of animals is incorrectly justified by a form of prejudice against animals called **speciesism**. On the other hand, many scientists (including the authors) argue that animal research is essential for scientific progress, that much animal research does not result in pain and loss of life, and that the benefits of such research are enormous both for humans and other animals. Nonetheless, it is important that researchers treat their animal subjects as humanely as possible.

Research with drugs poses other ethical issues. In addition to considerations about the welfare of the subjects while they are participating in the research, researcher should also be ready to provide **aftercare** for the human participants. Drug research also requires that the investigator conform with various legal requirements.

Ethical decisions are often difficult to make; sometimes ethical principles are in conflict. Institutions engaged in research that receive money from the federal government, are required to have an **Institutional Review Board** that helps monitor ethical practices in research, and ensure ethical treatment of participants.

KEYWORD MATCHING

_____aftercare
_____confidentiality
_____debriefing
_____deception
_____freedom to withdraw
_____informed consent
_____Institutional Review Board
_____protection from harm
_____removing harmful consequences
_____speciesism

A. a committee that monitors ethical practices at an institution
B. allowing a subject to call a halt to his continued participation in a study
C. belief that sacrifice of animals is justified if humans benefit
D. ensuring that an subject is in as good physical and mental shape at the end of an experiment as at the beginning
E. explaining to a subject the purpose of an experiment at its conclusion
F. given by the subject before participation in study
G. masking the true purpose of research to reduce reactivity
H. not talking about the experimental performance of individual subjects
I. responsibility for possibly long term effects produced by drug related research
J. the overriding ethical principle

PROGRAMMED REVIEW

1. Most universities and research institutions have _____ _____ _____ to monitor the ethicality of research.

2. Individuals should read and understand the ethical principles of the American Psychological Association _____ they conduct a research project with human participants,

3. Subjects should be warned ahead of time if there is any potential _____ that might result from serving in the experiment.

4. The experimenter is obliged to _____ any harm that the subject may experience as a consequence of participating in the research.

5. Psychologists who conduct research with human subjects are obliged to respect the _____ and _____ of the participants in the research.

6. Individuals must be give the option of _____ from the research at any time.
7. The investigator must protect both the _____ and the _____ state of the research participants.
8. If a researcher divulges too many details of an experiment this could result in a(n) _____ research project.
9. When students taking an introductory psychology course are required to participate in an experiment as part of a course requirement, they should have some _____ way of fulfilling this requirement.
10. _____ means that the experimenter explains the general purposes of the research and the nature of the manipulations used.
11. Unless otherwise agreed, what a subject does in an experiment should be _____.
12. There is often no _____ _____ as to what is ethical.
13. _____ is a form of racism involving claims about scientific progress being helped by animal research.
14. As a model for _____ behavior, animal research is essential for scientific progress.

EXPERIMENTAL PROJECT

This project is designed to get you to consider in more detail the issues of ethics in research. Make up short list of experiments that you think are in some way unethical, but that you might like to perform just to see what happens. Visit faculty members who specialize in the research areas of your experiments and ask then it they would be willing to supervise the experiments.

Did the faculty members question the ethics of your proposed experiments? How many faculty members told you that they refuse because the proposed research is unethical? How many tried to see if there might be a way to answer the question posed in your research, but using an ethical experiment? Finally after reading the issues raised in the chapter, would you consider this an ethical project? Why or why not?

EXPERIMENTAL DILEMMA

A social psychologist is interested in studying how decisions are made concerning ethics in research by Institutional Review Boards. In other words, she wants to study the university committee that decides whether or not a proposed research project conforms to conventional ethical standards. The problem confronted by this researcher is that she needs to get the approval of this committee before she can study them.

Is it possible to conduct valid research on this issue? What ethical problems might the researcher face? How could she avoid demand characteristics. or reactivity, from affecting her results? Assume for the moment that one of the ways this psychologist intends to study the decision-making process is to submit fake research proposals under the name of another researcher who consented to this procedure. Some of these proposals would violate ethical standards, others would not. Is this an ethical approach? How might you design a research project to address the problem of interest (i.e., the decision-making process)?

MULTIPLE CHOICE QUESTIONS

1. The principle of informed consent means that the researcher has an obligation to
   a. submit all research proposals to an Institutional Review Board that will judge the ethics of the proposed research.
   b. tell subjects prior to participation all aspects of the research that might reasonable be expected to influence the subject's willingness to participate in the study.
   c. only disclose the results of the experiment after he has obtained the consent of all subjects who participated in the study.
   d. agree to perform the research only after he or she is certain that no ethical standards are being violated.
   e. all of the above
2. In an ethical research project
   a. informed consent is obtained from all participants.
   b. participants may withdraw at any time.
   c. the potential gains outweigh the potential harm.
   d. all of the above
   e. both *a* and *b*

3 One problem associated with providing enough information for informed consent is that
   a. the validity of the experimental design may be undermined.
   b. people may avoid participating in psychological research even low risk studies.
   c. some research projects may not be able to obtain subjects.
   d. it is a time-consuming process.

4 Debriefing means that
   a. the investigator is aware of the risks involved in the experiment.
   b. the investigator explains the general purpose of the research after the study is completed.
   c. the investigator provides the IRB with an abstract of the proposed research project.
   d. after a blind experiment is run the investigator tells t research assistants what the purpose of the experiment was.

5. Animals are often used in psychological studies because
   a. ethical considerations are generally less stringent with animal research than with human research.
   b. animals are interesting in their own right.
   c. animals form an important part of the natural world.
   d. all of the above

6. Singer (1978) calls claims about scientific progress being helped by animal research
   a. anthropomorphism.
   b. explicitly unethical.
   c. speciesism.
   d. unfounded.
   e. all of the above

TRUE-FALSE QUESTIONS

_____ 1. Any federally funded research must be approved by an IRB before any funding is granted.

_____ 2. In a research project every member of the research team is responsible for ensuring ethical practice in research.

_____ 3. No deception was involved in the study of the effects of depression on memory.

_____ 4. Providing information for informed consent generally helps improve the validity of the experimental design.

_____ 5. In ethical research, participants are always allowed to withdraw from an experiment regardless of what their reasons are for withdrawing.

_____ 6. Informed consent is generally obtained in writing during the debriefing session.

_____ 7. Confidentiality means that, in general, results of an experiment are not published unless the subject gives his or her approval.

_____ 8. There are usually clear answers to ethical decisions.

ESSAY QUESTIONS

1. Under what circumstances (if any) might an IRB allow an experiment involving deception to be conducted?
2. Describe in your own words, the argument used in the text to justify research on animals.

Chapter 5

How to Read and Write Research Reports

IN OTHER WORDS

To derive the greatest benefit from reading a psychology journal article, it is important that you read critically. Each section of an article contains information tat is useful in deciding whether to read the article, and in evaluating the article and the research reported. Psychology journal articles are generally written according to guidelines prepared by the American Psychological Association, the **APA format**.

The **title** gives you an idea of the contents of the article, usually naming the dependent and independent variables under investigation. The **author(s)** of the article may encourage you to read it, if you are familiar with their other research.

The **abstract** is a short paragraph that summarized the key points of the article, and is a good place to begin reading. The **introduction** specifies the problem to be studied, and indicates why the problem is important.

The **method** section explains how the study was conducted in sufficient detail to allow someone else to replicate the study. The method section is usually divided into subsections that describe the **subjects**, the **apparatus** and/or **materials** used in the research, and the **procedure,** including the research **design** that was employed.

The **results** section generally describes what happened in the study. Summaries of the data collected are presented in **tables** or graphical **figures**.

The **discussion** section is where the author interprets the results of the study, and may draw theoretical conclusions. Previous research cited in the article are listed in the **references** section, found at the end of the article.

A **checklist for critical readers** is presented in the text, and is designed to help you learn to read and evaluate articles effectively.

Writing and trying to publish the results of a research project can be a long and tedious task. However, it is important that the results of carefully done research are communicated the others who are interested in the problem being studied. Knowing what readers of journal articles look for in an articles will help to ensure that your written reports provide the sought-after information.

KEYWORD MATCHING

_____abstract	A. appears after the title on first page
_____APA format	B. citations of previous research
_____apparatus	C. describes equipment used in study
_____author	D. graphs of summarized data
_____checklist for critical readers	E. guideline for organization of article
_____discussion	F. guideline for reading journal articles
_____figures	G. names independent and dependent variables
_____introduction	H. non-graphical data summary
_____materials	I. operations performed by researcher
_____method	J. selection of participants is described
_____procedure	K. summary of the key points of article
_____references	L. top of each page in a published article
_____results	M. a questionnaire would be presented
_____running head	N. where research design is specified
_____subjects	O. where problem is presented
_____tables	P. where results are interpreted
_____title	Q. where what happened is described

PROGRAMMED REVIEW

1. The seven parts of a basic psychology article are
   a)_____and_____, b)_____, c)_____,
   d)_____, e)_____, f)_____, and g)_____.

2. A good title conveys the _____ of the article.

3. Most titles state the _____ and _____ variables.
4. The first step in deciding which articles you might want to read is to consult the _____ of _____ of the journal.
5. The _____ is a short paragraph that summarizes the key points of the article.
6. The _____ are found at the end of an article.
7. The introduction should specify the problem to be studied, the _____ to be tested, and the rationale behind any _____.
8. If you wanted to replicate an experiment, you would need to consult the _____ section of the article that describes that experiment.
9. The method section is often divided into subsections that describe the _____, _____ or _____, and the _____.
10. The _____ section contains a summary of what happened in the experiment.
11. If different figures are included in an article it is important to check that the _____ are comparable so that the effects can be compared across figures.
12. Extra skepticism on the part of the reader is required for the _____ section.
13. In the introduction, the _____ are usually obvious and stated, while the answer to the question _____ is somewhat less clearly stated.
14. Before you read the method section, you should try to design an experiment to test the _____ stated in the introduction.
15. After you have read the method section you should check to see that the methods used are adequate for testing the _____.
16. You should try to predict the results for the experiment before reading the _____ section.
17. In an APA-style report, the cover sheet includes a)_____, b)_____, and c)_____.
18. Page two of a research report contains the _____.

19. The _____ _____ from the manuscript appears on the top of each page in the published article.
20. The title of a research project appears on the _____ sheet, and immediately preceding the _____.
21. The biggest stylistic problem in most research reports is _____ from one section to the next.
22. The _____ tense should be used in the introduction and method sections, and the _____ tense is generally acceptable for the results and discussion sections.

EXPERIMENTAL PROJECT

The best way to get good at reading journal articles is through practice. The more articles you are able to read, the more proficient you will become at reading reports. Each time you read an article you should try to answer all of the questions listed in the checklist for critical readers. For further practice reading journal articles, consult your university library. The *Bulletin of the Psychonomic Society* is a good source for articles to use for practice reading, since there is a limit of four pages for articles that appear in that journal. Finally it is a good idea to get together with classmates and decide on one or more articles to read. After you have read the article(s), and written out your answers to the checklist questions, you should compare your answers with those of your classmates.

MULTIPLE CHOICE QUESTIONS

1. Each of the following is a part of a journal article except the
   a. introduction
   b. method
   c. results
   d. discussion
   e. summary
2. In the introduction of a journal article, the author should
   a. specify the problem to be studied.
   b. specify the hypothesis (or hypotheses) to be tested.
   c. give the rationale behind any predictions.
   d. all of the above

3. Which of the following should be included in the method section?
   a. considerations concerning subjects
   b. a description of the apparatus
   c. the procedures used in the experiment
   d. all of the above
   e. both *a* and *b*

4. Which of the following would be unusual to find in the results section?
   a. raw data
   b. summary statistics
   c. inferential statistics
   d. figures
   e. all of the above are usually found the results section

5. The interpretation of the experimental findings is found in the
   a. abstract
   b. introduction
   c. method
   d. results
   e. discussion

6. The answer to the question "What hypothesis will be tested?" can be found by reading the
   a. abstract
   b. introduction
   c. method
   d. results
   e. discussion

7. The question "What is the independent variable?" can be answered by reading the
   a. abstract
   b. introduction
   c. method
   d. results
   e. discussion

8. The question "Are the results expected?" can be answered by reading the
   a. abstract
   b. introduction
   c. method
   d. results
   e. discussion

9. The critical reading question "Is my interpretation better than the author's?" should be answered by reading the
   a. abstract
   b. introduction
   c. method
   d. results
   e. discussion

10. In preparing a laboratory report or a journal article, you should use headings for all of the major sections of the paper **except** the
   a. abstract
   b. introduction
   c. method
   d. results
   e. discussion

TRUE-FALSE QUESTIONS

____ 1. The introduction of a journal article specifies the hypothesis to be studied, and briefly describes the experiment designed to test the hypothesis.

____ 2. Statistical design features of an experiment are described in the method section of a journal article.

____ 3. The statement "$F(6,20)=7,40$, $p<.01$" means that the odds of obtaining an F-statistic at least as large as 7.40 by chance would be less than one percent.

____ 4. In the discussion section of a journal article, the author is free to interpret the results, and thus the reader must accept the author's interpretation.

____ 5. The most important question for the reader to answer after reading the method section is: "Is this how I would design an experiment to test this hypothesis?"

____ 6. It is appropriate to use the past tense in the review of other studies in the introduction.

____ 7. Use of the passive voice whenever possible is encouraged in scientific writing.

ESSAY QUESTIONS

1. Name the sections of a journal article, and describe the function of each section.
2. Why is it important to be wary of statements like "although the improvement observed following training did not quite achieve statistical significance, it is clear that the data revealed a trend in the expected direction."?

Chapter 6

Psychophysics

IN OTHER WORDS

Psychophysics is the study of the relationship between stimuli, measured physically, and sensations, the psychological responses to stimuli. Historically, psychophysics has been concerned both with detecting weak stimuli, or small changes in simulus intensity, and with measuring the magnitude of sensations evoked by stimuli of different intensities.

The idea of a **threshold** is the minimum amount of stimulation that can be detected. Psychologists talk about both absolute and difference thresholds. The **absolute threshold** is the smallest stimulus intensity that can be detected at all, while the **difference threshold** is the smallest change in stimulus intensity that is detectable. Thresholds are measured by using one of the **psychophysical methods**. One of the first psychophysical laws, **Weber's Law**, states that the size of the difference threshold is a constant proportion of the original stimulus intensity: if you were holding 10 grams , and an extra gram produced a **just-noticeable difference** in weight, then you could barely detect the difference between 100 and 110 grams.

The **method of limits** is one of the classical psychophysical methods. To measure the absolute threshold with this method, the subject is presented alternately with series of trials in which the weak stimuli either increase or decrease in intensity by small steps. The point of transition between a detection and a nondetection response is noted for each series. The absolute threshold is **operationally defined** as the average of these transition points. When the method of limits is used to

measure difference thresholds, the increasing or decreasing stimuli within a series of trials are judged against a fixed standard stimulus, and the subject reports whether the comparison stimulus is greater than, equal to, or less than the standard. Again the transition points are recorded, and averaged after a sufficient number of trials. The average transition between "greater" and "equal" responses is operational definition of the upper difference threshold, and the average transition between the "equal" and "less" responses defines the lower difference threshold. The **interval of uncertainty** is operationally defined as the difference between the upper and lower difference thresholds. The **point of subjective equality** is operationally defined as the average of the upper and lower difference thresholds. The **staircase method** is a more recent version of the method of limits that affords more efficient data collection.

The **theory of signal detection** provides a more modern way of looking at responses to weak stimuli. According to this theory, all weak stimuli, called signals, are heard against a background of **noise**, that randomly varies in intensity from moment to moment. The noise at a particular instant produces a sensory impression of a magnitude that is related to the momentary intensity of the noise. When a signal is present, it increases the sensory impression by a fixed amount symbolized by **d'**. When the signal is weak, i.e. d' is small, there is overlap of the sensory impressions elicited by the noise, and those elicited by the signal plus noise. On each trial subjects report whether or not a signal was present. They do this by establishing a **criterion** point on the dimension of sensory impressions, called β (**beta**). If on a particular trial, the sensory impression exceeds β, the subject reports that the signal was present, otherwise the signal is judged to be absent. When a signal is present, the sensory impression is more likely to exceed β that when the signal is absent. A **hit** is the response that a subject makes when detecting a signal that was actually presented. But, because the distributions overlap, the subjects will make some mistakes. A high momentary level of only noise will produce a sensory impression that exceeds β, and the subject will say 'yes' in the absence of the signal; such a response is called a **false alarm**.

A **receiver-operating characteristic (ROC)** function is a graph that shows the relationship between the proportion of hits and false alarms. These data allow the calculation of both d' and β. The effective signal strength, or the sensitivity of the subject, is measured by d'; β reflects the psychological decision processes of the observer. Increasing the strength of the signal increases d', without necessarily affecting β. Changing the rewards and punishments for correct and incorrect responses, and changing the probability that the signal will occur, effect

measurements of β, but have no effect on d'. Results of signal detection studies suggest that there is no such thing as a single fixed threshold.

Measurement is assigning numbers or names to objects or properties of objects. **Measurement scales** differ in the degree to which they provide information. **Nominal scales** are the least informative of the measurement scales, in that they are sensitive only to the **difference** among the measured objects. Objects that do not differ are assigned the same name or number, while objects that do differ are assigned different numbers. A postal zip code is an example of a nominal scale. **Ordinal scales** are sensitive to both differences and **magnitudes**. Objects with more of the measured attribute are assigned larger numbers than objects with less of the attribute. The Mohs scale of hardness is an example of an ordinal scale. If two minerals are rubbed together, the harder mineral will scratch the softer, and receive a higher number. **Interval scales** are sensitive to differences, magnitudes, and in addition, measure with **units of equal size**. The Fahrenheit temperature scale is an interval scale. **Ratio scales** have all the properties of interval scales, and in addition, have a **true zero** point. Only with a true zero is it meaningful to say that one measurement is twice as much, or half as much as another. Height in inches is an example of measurement at the interval level.

Psychophysical scaling involves measuring the magnitudes of sensation that are evoked by stimuli of different intensities. **Fechner's law**, based on Weber's law, states that the magnitude of sensation is a linear function of the log of the stimulus intensity. **Stevens' law** states that the magnitude of sensation is a function of the stimulus intensity raised to some power. The text suggests that Fechner's procedures are **indirect**, and measure sensations at only the ordinal level. Stevens used a **direct scaling** method of measuring sensation, called **magnitude estimation**, which results in a ratio level measure of sensation.

Most research in psychophysics involves the use of small numbers of subjects, and many trials with each observer. These **small-n designs** provide a great deal of experimental control.

KEYWORD MATCHING

1.
B absolute threshold
____ decision threshold
A difference threshold

A. the minimum intensity of a stimulus that can be detected 50% of the time
B. the smallest amount of change in stimulus intensity that can be detected 50% of the time
C. the smallest sensory impression that can be detected 50% of the time
D. the smallest sensory impression that will elicit a "yes" response in signal detection
E. the step size in the staircase method

2.
A magnitude estimation
C method of limits
D staircase method

A. used by Stevens to scale sensation
B. used by Fechner to scale sensation
C. classical psychophysical method used to determine thresholds
D. a more efficient variation of a classic psychophysical method
E. used to measure d'

3.
A Fechner's law
B Stevens' law
C Weber's law

A. sensation is a function of the log of the stimulus intensity
B. sensation is a function of the stimulus intensity raised to some power
C. the size of a just-noticeable difference is a constant proportion of the original stimulus intensity
D. there is no such thing as a fixed absolute threshold

4.
A nominal
C interval
B ordinal
D ratio

A. difference
B. difference + magnitude
C. difference + magnitude + equal intervals
D. difference + magnitude + equal interval + true zero

5.

B β
G d'
E false alarm
F hit
D interval of uncertainty
A point of subjective equality

A. average of the upper and lower difference thresholds
B. decision criterion
C. noise strength
D. range of intensities between upper and lower difference thresholds
E. saying "yes" to noise only
F. saying "yes" to signal + noise
G. signal strength
H. stimulus intensities below the absolute threshold

PROGRAMMED REVIEW

1. Psychophysical methods are techniques used by psychologists to measure psychological reactions to events that lie along a Psychological dimension.
2. The procedures used by an investigator to produce a concept (e.g., pain) represents a(n) Operational definition.
3. If an observer in a psychophysical study is presented with a single stimulus and must report whether the stimulus has been presented, or how much of the stimulus was present, the dependent variable is a(n) absolute judgment.
4. If an observer in a psychophysical study is presented with a pair of stimuli and must report which stimulus is greater, the dependent variable is a(n) difference judgment.
5. The independent variable in a psychophysical experiment is most likely to be the magnitude or the quality of the stimuli used in the study.
6. The observer's willingness to make a particular response is the primary control variable in psychophysical experiments.
7. The most common method of providing a technical meaning of a concept is by means of a(n) Operational definition.
8. An operational definition is a formula for defining a construct in such a way that other scientists can duplicate

9. An operational definition does not have to make sense, but it must be stated so that it can be duplicated.
10. The method of limits is a procedure for statistically estimating the best value of an absolute threshold.
11. Alternating trial blocks of increasing and decreasing stimulus intensity are used to establish absolute thresholds with the method of limits.
12. A threshold that is based on the observer's ability to detect the presence if a stimulus is called a(n) absolute threshold.
13. difference thresholds are based on relative judgments, where an unchanging comparison stimulus is judged in relation to a series of changing stimuli.
14. The difference between the upper and lower difference thresholds is called the interval of uncertainty
15. The mean of the upper and lower difference thresholds is called the point of subjective equality.
16. Weber's psychophysical studies revealed that the magnitude of the difference threshold (increases/decreases) increases with decreases in the magnitude of the standard stimulus.
17. In Weber's law ($\Delta I/I=K$), **I** refers to the magnitude of the standard stimulus, ΔI refers to the difference threshold, and **K** is a constant for that stimulus modality.
18. Weber's law has been shown not to hold for weak values of stimulus intensity.
19. One difference between the traditional method of limits and the staircase method is that the staircase method concentrates the subjects' responses around the threshold
20. According to signal detection theory, there is no such thing as a fixed threshold.
21. Signal detection theory argues that internal sensory and decisions processes are involved in perception.
22. In a psychophysical experiment, the observers' decisions are based upon the costs and the benefits associated with those decisions.

23. According to signal detection theory, noise is always present in the detection task.

24. According to signal detection theory, any stimulus produces a distribution of sensory impressions.

25. According to signal detection theory, the hypothetical distributions that play a role in our perception are called the noise distribution and the signal + noise distribution.

26. In a signal detection experiment, the observer must set a criterion to determine if a response will be *Yes* or *No*. This criterion is set by the decision processes.

27. Saying *Yes* when there is a signal present is called a(n) hit. Saying *Yes* when the signal is not present is called a(n) false alarm.

28. d' refers to the sensitivity of the observer, or the strength of the stimulus.

29. The criterion of the decision process is called Beta.

30. Flat slopes on the receiver operator characteristic (ROC) reveal (liberal/conservative) liberal decision criteria, whereas steep slopes signify conservative criteria.

31. As the signal becomes more discernible to the observer, the noise and the signal + noise distributions should move (closer to/further from) further from each other.

32. The decision criterion can be manipulated by varying the hits and false alarm for correct and incorrect responses, and by varying the presence of the signal.

33. According to signal detection theory, detecting and reporting the presence of a signal is determined by the values of d' and beta.

34. A point on an ROC function is determined by the proportion of hits, plotted on the abscissa, and the proportion of false alarms plotted on the ordinate.

35. Signal detection theory allow researchers to measure independently the subjects' sensitivity and their response bias.

36. Research by Clark and his colleagues has demonstrated that acupuncture serves to modify people's decision but does not alter their sensitivity to pain.

37. The property of a ratio scale that allows one to say that X is twice as much as Y is a true zero.

38. In an interval scale of measurement, there is no true zero point.

39. In a(n) ordinal scale, there is no true zero point, and the distances between adjacent scale values are unequal.

40. A nominal scale sorts objects into different numbers

41. According to Fechner, the ~~detection~~ absolute threshold corresponds to the zero point of sensation along out internal psychological scale,

42. Fechner believed that just noticeable differences produce equal increments in sensation.

43. Fechner's law states that the ratio-scale value is proportional to the inverse function of the physical stimulus value.

44. Fechner's law is based on the assumption that our internal psychological scale for sensation is a(n) ratio scale.

45. In a(n) direct scaling technique, the observer responds in psychological scale units.

46. In the method of magnitude estimation the observer states a number that represents the intensity of the sensation.

47. in a small-n design, experiment control replaces statistical control as a method for reducing error variance. This serves to (increase/decrease) the reliability of the data.

48. In a psychophysical experiment, the number of subject is small, but the number of observation is very large.

EXPERIMENTAL PROJECT

Weber's law can be demonstrated with the chemical sense of taste, using salt as the stimulus. Mix 1 Tbs. of salt into each of two identical glasses filled with 8 oz. of water. (Be sure to have the same temperature of water in each glass.) Your observer

will be blindfolded, and he or she should not be able to tell the two glasses apart by weight, or touch.

To begin, let your subject have a small sip from each glass, and to report which glass tastes saltier, or whether they seem equally salty. Add /16 tsp. of salt to one of the glasses, stirring until it is dissolved. Repeat the tasting, and salt addition until the glass with the extra salt is reported to taste saltier. Record the amount of salt added before the difference was noticed; this amount is one just noticeable difference.

Add the same total amount of salt to the standard glass, so that again both glasses have the same concentration. Repeat the process, and see how must salt you have to add to the new sample before your subject can detect a difference.

If you repeat the process several times, you will have several values for just noticeable differences, each from a slightly saltier standard. Do your values agree with Weber's law? How might this demonstration be improved?

EXPERIMENTAL DILEMMA

A researcher is interested in examining the effects of biorhythms on various physical and psychological abilities. Toward this goal, she decides to measure the absolute threshold early in the morning, and then late at night. Each morning the researcher went to her laboratory at 6:00 a.m. and tested her subject's absolute threshold, using the method of limits, for detecting a 400 Hz tone embedded in white noise. At night the subjects reported to the University Sleep Lab to be tested. The Sleep Lab was equipped with a computer which made it easy to test the subjects' absolute thresholds using the staircase method. As in the morning, the stimulus was a 400 Hz tone embedded in white noise.

The results show that, on average, the subjects' absolute thresholds were lower in the morning than in the evening. The researcher concluded that time of day has an effect on auditory absolute threshold, with people being more sensitive in the morning than late at night.

Do you agree with her conclusion? Which features of the experimental procedure do you think might be improved so as to provide a better test of the hypothesis?

MULTIPLE CHOICE QUESTIONS

1. If you wanted to turn up your stereo so that you would perceive the sound to be twice as loud as it was before, you would have to increase the physical sound energy by approximately _____ times as much as it was previously.
   a. two
   b. four
   c. six
   d. ten

2. The energy level present in an auditory signal is the physical correlate of the psychological dimension of
   a. loudness
   b. pitch
   c. intensity
   d. timbre

3. The most common way for a scientist to provide a technical meaning for a concept is by using
   a. an operational definition.
   b. a common definition.
   c. a dictionary definition.
   d. a hypothetical construct.

4. An operational definition of a concept (such as hunger or pain) involves stating
   a. what effect the concept has on the subject's behavior.
   b. what role the concept plays in our theories of behavior.
   c. the operations and procedures used to produce and measure the concept.
   d. how one could induce the concept in an animal subject using surgical techniques.

5. The method of limits is a psychophysical technique that is used to determine
   a. stimulus intensity.
   b. stimulus quality.
   c. decision thresholds.
   d. absolute thresholds.

6. The method of limits involves
   a. beginning each block of trials with a stimulus intensity that can be clearly perceived.
   b. beginning each block of trials with a stimulus intensity too low to be clearly perceived.
   c. alternating each block of trials between *a* and **b** above.
   d. either *a* or *b* but not both

7. A threshold based on an observer's ability to detect the presence of a single stimulus is called the
   a. difference threshold.
   b. relative threshold.
   c. decision threshold.
   d. absolute threshold.

8. In a task where the observer compared the weight of a constant comparison stimulus with the weights of a changing stimulus using the method of limits, the point of subjective equality is operationally defined as
   a. the mean of the stimulus value corresponding to the last *heavier* response and the first *equal* response.
   b. the mean of the stimulus value corresponding to the last *equal* response and the first *lighter* response.
   c. the difference between *a* and *b*
   d. the mean of *a* and *b*

9. Research has shown that Weber's law holds true for more than _____ of the range of standard stimuli tested in a particular sensory modality.
   a. 30%
   b. 50%
   c. 70%
   d. 90%

10. In Weber's law, the difference threshold is given by
   a. I
   b. ΔI
   c. ϕ
   d. $\Delta\phi$

11. The staircase method concentrates most responses around the _____.
   a. decision threshold
   b. absolute threshold
   c. d'
   d. interval of uncertainty

12. According to signal detection theory, perception is controlled by _____ and _____ processes.
    a. sensory; criterion
    b. threshold; criterion
    c. sensory; decision
    d. sensory; response bias
    e. neural; criterion

13. In signal detection theory, the criterion determines
    a. the hit rate.
    b. the false alarm rate.
    c. d'.
    d. all of the above
    e. *a* and *b*

14. You must decide whether (*Yes*) or not (*No*) to accept a blind date. By accepting the date you risk spending a boring evening. On the other hand, you also stand a chance of meeting a fascinating person and possibly beginning a beautiful relationship. According to signal detection theory you should adopt
    a. a conservative criterion.
    b. a liberal criterion.
    c. a large value of d'.
    d. a small value of d'.

15. According to signal detection theory, detecting a signal when both signal and noise are present is called a
    a. hit
    b. miss
    c. false alarm
    d. correct response

16. According to signal detection theory, reporting a signal when only noise is present is called a
    a. hit
    b. miss
    c. false alarm
    d. mistake

17. In signal detection theory, the value of d' is defined as the
    a. mean of the noise distribution.
    b. mean of the signal distribution.
    c. point at which the criterion divides the noise and signal distributions
    d. distance between *a* and *b*

18. In an ROC curve, you would expect to find a conservative response criterion in the _____ portion of the graph.
    a. upper right
    b. upper left
    c. lower right
    d. lower left

19. The scale of measurement that has the most stringent requirements is the _____ scale,
    a. interval
    b. nominal
    c. ordinal
    d. ratio

20. The Celsius scale of temperature is an example of a(n) _____ scale of measurement.
    a. interval
    b. nominal
    c. ordinal
    d. ratio

21. The number on an athlete's jersey is an example of a(n) _____ scale of measurement.
    a. interval
    b. nominal
    c. ordinal
    d. ratio

22. Fechner's law is based on a(n) _____ scaling method because the psychological scale is based on successive just noticeable differences. Stevens' power law is based on a(n) _____ scaling technique in which the observer responds in psychological scale units.
    a. direct; indirect
    b. indirect; direct
    c. direct; direct
    d. indirect; indirect

23. Psychophysical experimentation
    a. employ small-n designs
    b. involve extremely tight control of the experimental situation
    c. rarely require inferential statistics
    d. all of the above
    e. both *a* and *b*

TRUE-FALSE QUESTIONS

F 1. Psychophysical methods are techniques used by psychologists to measure attributes of the physical world in terms of their psychological values.

T 2. One operational definition of pain could be "applying a 10 volt electric current to the back of the hand for 20 seconds."

F 3. The method of limits is used to determine the length of time subjects can tolerate painful stimuli.

F 4. Absolute thresholds are based on relative judgment where a constant standard stimulus is judged relative to a series of changing stimuli.

F 5. In signal detection theory, the noise distribution refers to white auditory noise that is introduced in the experimental session.

T 6. According to signal detection theory, moving the criterion "to the left" will increase the number of false alarms and the number of hits.

T 7. Data obtained using a ratio scale of measurement could be analyzed by methods appropriate for interval, ordinal, or nominal data.

F 8. It is valid to say that 80° F is twice as hot as 40° F.

F 9. Even though psychophysical techniques involve extreme control of the experimental situation, inferential statistics are still needed are almost always used.

F 10. The "small-n" in small-n designs refers to the number of times a particular subject is observed.

ESSAY QUESTIONS

1. Why is it inappropriate to state that Fechner's work involved the use of a ratio scale? What kind of scale was Fechner actually working with?
2. What is the staircase method of establishing thresholds? How does this differ from the classical method of limits?
3. Describe how a change in response criterion can affect both the hit rate and the false alarm rate in a signal detection experiment.
4. Compare and contrast the psychophysical scaling techniques used by Fechner and Stevens.

Chapter 7

Perception

IN OTHER WORDS

Our sense organs deliver to us a wealth of sensations that arise from events in the environment. Making sense of this information is what **perception** is all about. Ordinarily our perceptual systems do a good job, but they can be tricked by **impossible figures** and **illusions** which are special stimuli that are not accurately interpreted. Illusions provide a convenient way to explore the perceptual processes.

There is a central debate going on about the nature of the perceptual processes. Some psychologists, e.g. Gibson, argue that perception is **direct** - reliable cues in the environment are immediately and correctly interpreted by perceptual mechanisms that have evolved to do just this job. According to this approach, what we perceive is determined by what is present in the environment, that is, perception is **data-driven**, and processing proceeds from the **bottom up**. The **indirect** approach assumes that our perceptual judgments are made on the basis of our expectations; what we perceive is in part determined by what we expect to perceive, and the perceptual mechanisms include **top-down,** or **conceptually driven processing**. This debate has gone on for years in various guises. **Empirical theory** is like the indirect approach, but emphasizes the importance of experience in learning how to use the cues provided by the environment, in making **unconscious inferences** that determine our perceptual judgments. Many visual illusions seem to result from our past experience in dealing with linear perspective and other depth cues. **Nativistic theory** is like theories of direct perception, but emphasizes the importance of the sensory systems rather than experience, in determining perception.

Another debate within perception deals with the role of conscious **awareness** in the perceptual processes. Some argue that we can interpret sensory information without conscious awareness, while others argue that awareness is a necessary component of perceptual experience. Studies on **perceptual defense** have found that taboo words must be exposed for longer durations than neutral words to be correctly reported. While seemingly this suggests that taboo words can effect behavior at durations too short from them to be perceived, it is more likely that subjects are simply less willing to vocalize vulgar words.

The phenomenon of **blindsight** seems to indicate that people can locate objects visually, without being consciously aware of what the objects are, or ever that there are objects at all. People who have blindsight have blind regions in their visual fields , called a **scotomas**, that result from cortical damage. The extent of the blind field can be measured with the technique of **dynamic perimetry**.

Another possible example of perception without awareness is the effect of **priming** stimuli on the magnitude of the **Stoop effect**. In the original Stroop experiments it was found that people have difficulty naming the color of ink that is used to spell the name of another color. Recent work has shown that people also take longer to name a color if the color is preceded by a brief exposure of the name of another color. In these experiments a **tachistoscope** was used to flash the color name at the subject, and then to immediately present a brief **masking** stimulus. Under these conditions the subjects reported that they were unaware of the initial color name. Careful analysis of these experiments suggests that it is reasonable to distinguish between an **objective threshold** and a higher **subjective threshold** that correspond to different levels of perceptual analysis. Priming stimuli presented at durations below the objective threshold are apparently without effect. Primes presented above the objective but below the subjective threshold produce a Stroop effect, but subjects claim that they cannot detect or recognize the verbal input until the duration exceeds the subjective threshold.

Experimentation in perception makes use of a variety of dependent variables, including the **verbal report** of the observer, reaction time to respond to a stimulus, and confidence ratings. Whenever possible, it is advantageous to use an immediately verifiable response so that the experimenter can determine whether a subject's response is correct. Independent variables include the physical characteristics of the stimuli to be responded to, and experimental situations that reduce or distort sensory input. Control variables include physical aspects of the stimuli that are not under investigation, and emotional and motivational aspects of the experimental situation.

Many of the processes that are involved with performing cognitive and perceptual tasks are not directly observable. One approach to identifying and validating the existence of such processes is to use two or more sets of operations that eliminate alternative concepts that might explain a set of experimental results. This procedure is known as **converging operations** and it has proven quite valuable in studying perceptual processes. One tactic used to provide converging operations is called **double dissociation of function**. This strategy have been used in the investigation of blindsight, and the results of surgical experiments on animals suggests that there is a subcortical part of the visual system that analyzes "where" information and presumably underlies blindsight, while the cortical regions of the visual system provide conscious awareness and analyze the "what" information in visual perception.

KEYWORD MATCHING

1.

_____bottom-up processing
_____direct perception
_____empirical theory
_____indirect perception
_____nativistic theory
_____top-down processing

A. perception is conceptually driven
B. perception is data-driven
C. perceptual processing begins with expectations
D. perceptual processing begins with sensation
E. theory that biology of sensory system and reliable environmental cues are sufficient to account for perception
F. theory that learning and experience is necessary for accurate perception

2.

_____blindsight
_____hallucination
_____illusion
_____impossible figure
_____perspective
_____scotoma
_____size constancy

A. cue to depth perception
B. distorted, inaccurate perception
C. perception that a object is the same size when viewed from different distances.
D. perception without awareness of the location of a stimulus
E. perceptual experience without corresponding stimulus
F. region of blindness in the visual field
G. stimulus in which depth cues are improperly related

3.

_____dynamic perimetry
_____masking
_____priming
_____tachistoscope

A. used to bias an observer
B. used to limit the awareness of a biasing stimulus
C. used to measure size and location of scotoma
D. used to present visual stimuli for short periods of time

4.

_____awareness
_____objective threshold
_____perception
_____sensation
_____subjective threshold
_____unconscious inferences

A. automatic habit of incorporating depth cues in interpreting visual scenes
B. consciousness
C. information delivered from the sense organs
D. interpretation of sensation
E. minimum exposure duration at which observer is aware of the priming stimulus
F. minimum exposure duration at which priming stimulus affects behavior

5.

_____converging operations
_____double dissociation of function
_____perceptual defense
_____phenomenological experience
_____Stroop effect
_____verbal report

A. common dependent variable in perception experiments
B. internal awareness of the world
C. naming the color of an ink is slowed when the ink spells the name of another color
D. provided information supporting "what" and "where" systems
E. set of operations that serve to eliminate alternative explanatory concepts
F. vulgar words require longer exposure for accurate reporting than neutral words

PROGRAMMED REVIEW

1. Detecting the presence of external objects is referred to as the process of _____. The interpretation and recognition of these objects is called _____.

2. The theoretical approach that maintains we pick up environmental information naturally and without reflection upon this information is the _____ approach to perception.
3. The view that perception is based on out past experience with perceiving is known as the _____ approach.
4. The waterfall drawn by Escher presented in the text is an example of a(n) _____ figure.
5. _____ and relative _____ are two cues used in depth perception.
6. _____ constancy occurs when depth cues are used by an observer to account for distance between the observer and the perceived object.
7. The photograph in the text showing two men who appear to be quite different in size is an illusion of _____.
8. Bottom-up perceptual processes rely on _____ data, whereas _____ processes involve the use of _____.
9. If we interpret a photograph by inferring that the perspective cure we sense mean depth, Helmholtz would call this a(n) _____ inference.
10. According to the _____ theory, it is the nature of our sensory systems that determines our perception of the world.
11. A blind part of the visual field is called a(n) _____.
12. Visual capacity in a scotoma where there is no awareness of perception is called _____.
13. Although verbal report is probably the easiest dependent measure for a researcher to obtain, it has the disadvantage that it lacks _____.
14. The most common class of independent variables in perception studies are those that vary the _____ characteristics of the stimuli.
15. An observer gives a(n) _____ report when describing his or her perceptual experience.
16. A psychologist's confidence in the utility of verbal reports is increased when these reports are show to have _____ and _____.
17. A(n) _____ is the report of an experience in the absence of any apparent environmental stimulation.

18. The response of an observer can be employed as a useful dependent variable when a verifiable relationship between the report and the preceding _____ event can be directly inferred.

19. In a(n) _____ task, subjects are required to name the color of the ink that is used to print the word.

20. The Stroop effect is observed when the time needed to name the ink color (increases/decreases) _____ when the presented word is the name of a color other than the color of the ink.

21. The phenomenon of _____ refers to when a word or even biases the observer to see a subsequent event in a particular way.

22. To prevent his subjects from being aware of the priming word, Marcell followed the priming word with a visual _____.

23. The device used by Marcel to briefly present his visual stimuli is known as a(n) _____.

24. In Marcel's experiment, the primary _____ variable was the amount of time the subject took to press the correct button.

25. According to Chessman and Merikle, the _____ threshold is the threshold where responding is at the chance level, and the _____ threshold is where observers claim they cannot recognize the perceptual information.

26. _____ operations are two or more operations used to eliminate alternative explanations of an experimental result.

27. _____ _____ occurs when subjects require a longer period of time to pronounce vulgar words that ordinary words.

28. Zajonc (1962) showed that the _____ system is the locus for perceptual defense effects.

29. The two sets of observations provided by Chessman and Merikle that converge on the adequacy of the distinction between perception with awareness and perception without awareness are:
    a._____ and
    b._____.

30. The procedure of double _____ of function involves eliciting opposite behaviors by two tasks from different areas of functioning.

31. The warm-cool color distance illusion occurs when _____ colors appear to move toward the viewer, while _____ colors appear to recede away.

32. Color is composed of three attributes knows as _____, _____, and _____.

EXPERIMENTAL PROJECT

In addition to studying the perception of visual and auditory stimuli, psychologists have conducted research on our perception of the passage of time. What are some of the factors that affect our retrospective judgment of how much time has elapsed during a given period? A general consensus is that these retrospective judgments depend upon what happened during the interval in question, with longer estimate given for intervals during which more discrete events occur. For instance, you might estimate that more time had elapsed during an afternoon in which you had attended three classes and went shopping, than during an afternoon which you spent studying in the library.

You may investigate this hypothesis by testing subject in two experimental conditions. One of these conditions will involve only one activity whereas the other will involve several. The subject's task in the low activity condition will be to read a novel for one hour with no interruptions. Subjects in the high activity condition will listen to rock music for 20 minutes, solve a crossword puzzle for 20 minutes, and then read a novel for 20 minutes. At the end of each one-hour session subjects will give an estimate, in minutes, of the amount of time they believe to have elapsed. Use a within-subjects design so that each subject will be tested in both the low and high activity conditions. Counterbalance the order of conditions across the subjects such that half the subjects are tested in the low activity condition first and half are tested in the high activity condition first. You will want to test subjects individually since they might converse with each other if tested together, and this would introduce an artifact into the experimental procedure. Also be very careful to remove any external time estimation devices such as watches or clock from the testing room. Once you have obtained mean estimation times for both groups you can compare them using a *t*-test. Are the results consistent or inconsistent with the original hypothesis?

EXPERIMENTAL DILEMMA

An experimenter wishes to investigate the effects of attentional demands on the detection of auditory stimuli. The hypothesis is that detection performance will be poorer in a condition in which subjects must simultaneously perform a difficult task

than in a condition in which an easier task is performed simultaneously with the detection task. In the difficult condition, subjects will be instructed to count backwards by threes from a number presented on a TV screen (e.g., 100, 97, 94,...). The easy task will involve counting backwards from a presented number by ones (100, 99, 98,...). The auditory task will be the same for all subjects, and will require that a button be pressed whenever a tone is heard through a headset. Tones of low frequency and intensity will be presented at random intervals to both ears. Subjects in both conditions will be told to concentrate primarily on the counting task and to treat the auditory task as a secondary priority. Performance in the two conditions will be assessed using d' measures.

If you were to conduct this experiment, are there any improvements that you would make on the proposed design or procedure? If so, what would they be?

MULTIPLE CHOICE QUESTIONS

1. The indirect approach to perception argues that our perceptions of the world are based on
   a. our past experience with the environment.
   b. picking up on information provided by the environment.
   c. automatic processing of sensory information.
   d. both *a* and *b*
2. According to the indirect approach to perception, an appropriate analogy for the manner in which perception works would be
   a. filming a scene with a movie camera.
   b. taking a snapshot with a camera.
   c. putting together clues to solve a puzzle.
   d. making a mimeographed copy of a picture.
3. The concept of relative size refers to the fact that
   a. smaller objects are perceived as being further away that larger objects.
   b. loss of detail occurs as an object is brought closer to the observer.
   c. loss of detail occurs as an object recedes into the distance.
   d. large objects are more subject to size constancy confusion than small objects.

4. Even though the image formed on your retina is smaller for a distant car than for a closer one of the same size, you still
   a. judge the car that forms the larger image to be further away.
   b. judge both cars to be the same size.
   c. judge the nearer car to be larger than the more distant one.
   d. are unable to judge which car is larger.

5. Impossible figures are good illustrations of the fact that perception can be _____.
   a. organized
   b. measured
   c. unreliable
   d. constant

6. The fact that your mother, who you know to be five feet tall, looks five feet tall even when you see her from far away is as example of
   a. size constancy
   b. visual illusion
   c. hallucination
   d. perspective

7. When looking into a trapezoidal room which you assume is rectangular, you see two adult males, one peering through each window on the other side of the room. One person appears much larger than the other, and you perceive one person to be a midget and the other to be a giant because
   a. of the size of the retinal images produced by each face.
   b. your world knowledge governed your perception.
   c. of the phenomenon of size constancy.
   d. of the phenomenon of convergence.

8. The view that all of our knowledge about depth results from our past experience is known as
   a. a nativist theory.
   b. an empirical theory.
   c. a direct view of perception.
   d. a nature view of perception.

9. The procedure of assessing visual field defects known as dynamic perimetry is a variant of
   a. signal detection procedures.
   b. magnitude estimation procedures.
   c. difference threshold procedures.
   d. ascending method of limits trials.

10. The patient known as D.B. had the ability to
    a. see colors without form.
    b. locate objects he could not see.
    c. see objects but not identify them.
    d. localize sounds but not lights.

11. A phenomenological report
    a. occurs when an observer describes his or her perceptual experience.
    b. is useful only to the extent that it provides information about an event that the experimenter cannot observe directly.
    c. cannot be directly verified by the experimenter.
    d. all of the above

12. The essential characteristic of an adequate report of a perception is the
    a. conscious experience of the event.
    b. regularity of the report.
    c. reliability of the observer.
    d. relationship between it and the preceding perceptual event.

13. The Stroop effect is a phenomenon in which the time required to name to color of the ink used to print a work _____ when the word is a name of another color, as opposed to a neutral word.
    a. increases
    b. decreases
    c. remains constant
    d. increases for warm colors and decreases for cool colors

14. As the interval between a target word and a mask following the word is increased,
    a. recognition of the target word improves.
    b. subject report that the mask interferes with the target.
    c. the target and the mask appear as a single stimulus.
    d. the subject's confidence about the target word decreases.

15. In Marcel's experiment with the Stroop task, the Stroop effect was found
    a. only on aware trials.
    b. only on unaware trials.
    c. on both aware and unaware trials.
    d. only with congruent color words.

16. When Cheesman and Merikle replicated Marcel's study examining perception without awareness, they found that
    a. Marcel's results could not be replicated.
    b. Marcel's results were found only when subjects were actually aware of the priming word.
    c. the Stroop effect was not obtained when subject's prime detection performance was a chance levels.
    d. the visual mask actually had no effect on subject's performance.

17. The theory proposed by Cheesman and Merikle maintains that there are actually two thresholds, and they called these two thresholds
    a. detection and recognition
    b. subjective and objective
    c. awareness and experience
    d. phenomenological and experimental

18. Converging operations
    a. are a set of two or more operations used to eliminate alternative explanations for a set of experimental results.
    b. provide more than one way of arriving at an experimental conclusion.
    c. allow psychologists to distinguish between two competing explanations of an effect.
    d. all of the above

19. Which of the following is true about converging operations?
    a. They are useful in validating mental constructs.
    b. They are experimental operations that produce different results.
    c. They are a set of two or more experimental operations.
    d. both a and c

20. The finding that vulgar words are named more slowly than neutral words is called
    a. converging defense.
    b. perceptual defense.
    c. masking.
    d. the taboo effect.

21. Varying the percentage of convergent trials in a experiment using the Stroop effect effects performance
    a. when primes are below the subjective threshold.
    b. when primes are above the subjective threshold.
    c. on congruent but not incongruent trials.
    d. both and b

22. The warm-cool color distance illusion refers to the fact that
    a. artists use reds and yellows in the background of paintings to give the illusion of three dimensions.
    b. blues and greens in the foreground of a pictures denote three dimensions instead of two.
    c. reddish colors appear to move toward the viewer, whereas bluish hues appear to recede into the background.
    d. colors are perceived as being warmer when present near the viewer but cooler when moved further away.

TRUE-FALSE QUESTIONS

_____ 1. According to the direct approach to perception, our perceptual experience depends on our prior experiences.

_____ 2. The perception of depth when viewing a photograph of an outdoor scene is actually an illusion.

_____ 3. Although illusory or ambiguous figures are interesting, they are of little use when trying to understand the importance of various cues for ordinary perception, because these illusion rarely occur in the real world.

_____ 4. Haze is a cue that is used in depth perception.

_____ 5. Size constancy occurs when we fail to note that two objects are the same size when viewed from two different distances.

_____ 6. Artists use convergence in their paintings to create the illusion of distance.

_____ 7. The empirical theory of perception stresses the importance of learning and experience.

_____ 8. According to the nativistic view of perception, visual perception is determined by the structure of the visual system.

_____ 9. The text described a patient known as D.B. who could detect objects in his scotoma, but not in the blindspot where the optic nerve exits the eyeball.

_____ 10. The phenomenon of being able to respond to stimuli without being consciously aware of them is limited to the visual system.

_____ 11. The most common independent variables in perception studies are verbal reports.

_____ 12. A phenomenological report is a response to a perceptual event.

_____ 13. The report of an observer qualifies as a response only when a relationship between the report and a perceptual event can be inferred.

_____ 14. An hallucination is the report of an experience that does not correspond to the actual stimulus presented to the observer.

_____ 15. People are faster to say that red ink is red when the ink is used to print the word *table* than when it is used to print the word *green*.

_____ 16. A visual mask can be used to prevent the detection and identification of a word that immediately precedes the mask.

_____ 17. The objective threshold refers to stimulus presentation conditions in which the observer's levels of discriminative responding are above chance, yet they claim that they cannot detect the perceptual information.

_____ 18. The exposure time for the subjective threshold is longer than for the objective threshold.

_____ 19. At exposure durations between the objective and subjective thresholds, people claim to be unaware of stimuli, but their behavior indicated otherwise.

_____ 20. At least two converging operations are necessary to validate a mental construct.

_____ 21. Converging operations may be thought of a operational definitions.

_____ 22. Zajonc's (1962) experiment showed that the locus of perceptual defense is the response system.

_____ 23. A subject performing the Stroop task would be slower to name the color for the word *white* than for the word *dog* if both words were written in black ink.

_____ 24. The converging operations that support the distinction between perception and awareness are subjective and objective thresholds.

_____ 25. Double dissociation of function is analogous to the double blind procedure that is often used to rule out the effect of subject an experimenter biases.

____ 26. The saturation of a color refers to the frequency of the light comprising it.

ESSAY QUESTIONS

1. Briefly describe the direct and indirect views of perception.
2. What is meant by blindsight? Why is the phenomenon important for our understanding of the role of awareness in perception?
3. Describe the procedures used by Cheesman and Merikle to study priming without awareness. What aspect(s) of their results lead them to propose the two threshold theory?
4. What are converging operations? How were converging operations used to study the distinction between perception with and without awareness?
5. What is double dissociation of function? Give an example of a set of conditions that correspond to a double dissociation of function.

Chapter 8

Attention and Reaction Time

IN OTHER WORDS

In 1956 Broadbent proposed the first modern theory of attention, attempting to account for people's limited ability to pay attention simultaneously to more than one event . For example, the **cocktail party problem** is that it is difficult to attend to more than one conversation when there are several going on at once. Broadbent proposed an internal **filter** that accepts one message and discards others. An experimental task that is used to study attentional processes is **dichotic listening**, in which two different messages are presented, one to each ear. If the subject repeats one of the messages aloud as it is presented, a task called **shadowing**, the subject is unable to report subsequently much of the message delivered to the unshadowed ear.

Early work with the dichotic listening task contained a design flaw called **confounding**. Broadbent believed that the proposed filter operated on the physical **channel**, information from the unattended ear was prevented from being processed. But since the ear and the message varied together in early experiments, i.e., they were confounded, it could not be determined whether attentional filtering was operating on the basis of the physical separation of the two messages, or on their content. Gray and Wedderburn (1960) presented two messages to both ears, switching the ear that a particular message went to after each syllable. It was found that subjects reported what they heard on the basis of content, rather than on the basis of the location of the sound. Another confounding can occur when shadowing is involved. Norman (1969) investigated the possibility that the unshadowed message could not be recalled because of the interference produced by the

vocalization during the shadowing, rather than by an inability to attend to an unshadowed message.

Interest in reaction time began in the eighteenth century. This interest grew out of the observation that different observers disagreed about exactly when a star or planet crossed a line in the eyepiece of a telescope. The differences between observers, called **personal equations**, were found to be systematic, and most likely related to differences in reaction times between the observers.

Donders, a Dutch physiologist, became interested in reaction times because he thought that differences between reaction times in different tasks could be used to calculate the time required for various mental operations. The procedure of estimating the time required for various mental operations by determining differences between reaction times is called the **subtractive method**. **Donders A reaction** measures the **simple reaction** time of a subject's detecting and responding to a single stimulus. **Donders B reaction** measures the **choice reaction time** when a subject is presented with two different stimuli, one at a time, and must make a different response to each stimulus. The difference between and A and B reaction times is attributed to the mental tasks involved in identifying which stimulus was presented, and in selecting the appropriate response. The task in **Donders C reaction** involves presenting the subject with one of two stimuli, and requiring the subject to make a single response to only one of them. The difference in the A and C reaction time is attributed to the time required to identify the stimulus. The difference between the B and C reaction time is attributed to the response selection.

Subjects in reaction time studies are required to respond quickly. But when people respond quickly, the accuracy of their performance is often reduced. This phenomenon is referred to as the **speed-accuracy tradeoff**. Because of the speed-accuracy trade off, it is particularly desirable to add additional dependent variables to the reaction time experiments so that accuracy as well as speed can be measured. Thus, although Theios (1975) concluded that there was no effect of the probability that a digit would be presented on the time necessary to name that digit, Pachella (1974) found that accuracy of naming digits was increasingly impaired as the probability of the digit's being presented was reduced. A further example of the speed-accuracy tradeoff is Pashler's (1989) work on choice reaction times. In Pashler's experiment, subjects were presented with two different stimuli, and were required to make different responses to each stimulus. The major independent variable was the **stimulus onset asynchrony (SOA)** , the interval between the first and second stimulus. He found that with very short SOAs the reaction time to the second stimulus increased, and the accuracy of the second response decreased.

Presumably if the second stimulus is presented too quickly after the first, it arrives during the **psychological refractory period**, a period following a stimulus in which additional cognitive activities are difficult to manage. From careful examination of his data, Pashler concluded that the effect of short SOAs was on the selection of the appropriate response to the second stimulus.

Today **psychophysiology**, the relation between behavior and physiological events, is used in the study of reaction times and attention. An important psychophysiological tool is the **electroencephalogram (EEG)** which measures the electrical activity of the brain. **Alpha waves** are relatively slow waves with large amplitudes that are observed when subject are in a condition of relaxed wakefulness. **Beta waves** are faster and smaller waves that occur when people are alert or tense. When a subject is attending to a stimulus, beta waves increase in the parts of the brain that are associated with processing that stimulus.

When stimuli are presented to a subject, identifiable waves can be observed from particular brain loci, and at regular delays following the onset of the stimulus. These **event-related potentials (ERPs)** have proved to be particularly useful in studying attention and reaction time. For example, when an auditory stimulus is presented, a large negative wave occurs at about 100 ms. after the stimulus onset. This wave is called the **N100**, and is associated with the sensory analysis of the stimulus. After about 200 and 300 ms. positive waves are observed, the **P200** and **P300**, which are believed to be related to the onset of attentional processes. The P200 and P300 are usually larger when people are distracted from another task by the stimulus. Finally at 400 ms. following the stimulus onset, a negative peak is observed, the **N400**, which is greater when the subject is surprised.

The text used two psychophysiological studies to illustrate **interactions**, which occur when the effect of one independent variable is not the same at different levels of a second independent variable. Wilkinson and Lee (1972) presented three tones of different pitches to their subjects, and required that the subject keep count of one of them. They measured the amplitude of the P200 response to both the attended and unattended tones (independent variable 1) at various recording sites(a **quasi-independent variable**). They found that the attended tones produced greater p200 responses than did the unattended tones, especially when recorded from midline electrodes. Lorig (1991) had subjects keep count of the number of times a less frequent tone was presented, an **auditory oddball task**. Subjects performed this task under each of three intensities of a musk-like odor, zero concentration, a level below subjective threshold, and a detectable level of the odorant. Lorig found that the rare (counted) stimulus evoked greater amplitude P200 than the more frequent

(unattended) stimulus, and that P200 responses increased in amplitude with increasing concentrations of the odor. An interaction was revealed by the fact that increasing the concentration of the odor from unnoticed to noticeable increased the P200 amplitude for the attended tone, but reduced it for the unattended tone. These findings are consistent with the idea that odors play an important role in modulating the neural activity associated with cognition.

KEYWORD MATCHING

1.

_____Donders A reaction
_____Donders B reaction
_____Donders C reaction

A. one stimulus, one response
B. one stimulus, two responses
C. two stimuli, one response
D. two stimuli, two responses

2.

_____simple reaction time
_____choice reaction time

A. Donders A reaction
B. Donders B reaction
C. Donders C reaction

3.

_____channel
_____cocktail party problem
_____dichotic listening
_____filter
_____shadowing

A. ability to recognize your name in an unattended conversation
B. an ear, according to Broadbent
C. device that prevents processing of unattended information
D. inability to attend to more than one of several conversations
E. receiving two different messages, one in each ear
F. repeating a message aloud to control attention

4.

_____alpha waves
_____beta waves
_____N100
_____N400
_____P200
_____P300
_____electroencephalogram (EEG)
_____event-related potential (ERP)

A. associated with alertness and tenseness
B. associated with attentional processes
C. associated with introspective awareness of a stimulus
D. associated with restful wakefulness
E. associated with sensory processing of a stimulus
F. associated with surprise to an unexpected event
G. electrical potential that is time locked to stimulus presentation
H. monitoring brain wave with scalp electrodes

5.

_____confounding
_____interaction
_____introspection
_____quasi-independent variable
_____personal equation
_____subtractive method

A. differences in reaction time in reporting astronomical events
B. ear and message in early dichotic listening experiments
C. electrode placement in EEG studies
D. inferring the time of cognitive operations by differences in reaction times
E. odorant concentration and frequency of auditory stimulus
F. repeating one of two messages aloud
G. systematic way of examining one's consciousness

6.

____auditory oddball task
____pheromones
____psychological refractory period
____psychophysiology
____speed-accuracy tradeoff
____stimulus onset asynchrony (SOA)

A. counting the number of times an unusual sound is presented
B. odorants that provide sexual and social information
C. slow responses are more accurate than fast responses
D. time following stimulus presentation during which additional cognitive operations are difficult
E. time following a stimulus presentation at which a second stimulus is presented
F. use of physiological measures to understand psychological events
G. use of psychological measures to understand physiological events

PROGRAMMED REVIEW

1. The time interval between the occurrence of a stimulus and a response to that stimulus is known as the _____ _____.
2. The systematic differences among astronomers' measurements of crossing times led to the development of _____ _____.
3. In Donders A reaction time there is (are) _____ stimulus (stimuli) and _____ response(s).
4. The time between the onset of the stimulus and the response in a Donders A reaction is called a(n) _____ reaction time.
5. Another name for a reaction situation in which there is more than one stimulus and more than one response is a Donders _____ reaction, or a(n) _____ reaction task.
6. The mental operations involved in a Donders B reaction task are _____ identification and _____ selection.
7. The difference between a Donders B reaction task and a Donders C reaction task is that there is only one (stimulus/response) _____ in the C reaction task.

8. A Donders C reaction task requires _____ _____, but does not require _____ _____.
9. Subtracting the A reaction time from the C reaction time tells us how long _____ _____ takes.
10. A Donders _____ reaction time is subtracted from a _____ reaction time to tell us how long response selection takes.
11. Another name for Donders method of estimating the times required for various cognitive operations is the _____ method.
12. The dominant research method used in psychological inquiry during the earliest twentieth century was _____.
13. Using physiological events in order to understand psychological phenomena is called _____.
14. Recording the electrical activity of the brain from scalp electrodes is called _____.
15. _____ waves are usually recorded from awake but relaxed subjects, while beta waves are observed when the subject is _____ or _____.
16. Event-related potentials (ERPs) are _____ _____ to stimuli or other events that elicit them.
17. The N100 is a _____ potential that occurs _____ after the presentation of an auditory stimulus, and is taken as an indicant of the _____ _____ of the sound.
18. The P200 and P300 components of the ERP are associated with the onset of _____ to the stimulus, and are usually (larger/smaller) _____ to infrequent stimuli.
19. The N400 component of the ERP is observed when the subject is _____ by the stimulus.
20. The dependent variable used most extensively in studies of attention is _____ _____.
21. The percentage of correct responses is often used as a dependent variable in tasks in which _____ is involved.

22. In studies of attention, the key goal of most independent variables is to _____ the human performer.

23. Another name for one-thousandth of a second is a _____.

24. The task in which two different messages are simultaneously presented, one to each ear, is called a _____ _____ task.

25. When two or more factors in an experiment vary at the same time, they are said to be _____ , and we are unable to say which factor produced any observed effect.

26. In early dichotic listening experiments, _____ content and _____ were confounded.

27. Gray and Wedderburn found that subjects reported the (message/channel) _____ when each of two messages were presented alternately to both ears.

28. _____ is the name of the task in which the subjects repeat aloud the words of one of two simultaneously presented messages.

29. The key question in a shadowing experiment us generally related to what happens to the message presented to the _____ ear.

30. Norman (1969) argued that in a shadowing task, overt vocalization of the _____ _____ during shadowing interfered with the unshadowed message.

31. Norman hypothesized that the memory process of _____ was blocked by the overt vocalization of the shadowed message.

32. Norman argued that in the typical shadowing task, _____ and _____ processes were confounded.

33. When Norman unconfounded memory and attentional processes, his results led him to conclude that it is _____ _____ that are overloaded in the typical memory task.

34. Speed and accuracy are _____ related.

35. The relationship between how quickly a task is performed and the accuracy with which the task is performed is known as the _____-_____ tradeoff.

36. According to the speed-accuracy tradeoff, in order to perform a task with greater accuracy, the person must spend _____ time, and thus produce a _____ reaction time.

37. Because of the speed-accuracy tradeoff, reaction time experiments should include _____ _____ as a second dependent variable.

38. In Pasher's modification of Donders B task, there was a delay between the two stimuli. The delay is called the _____ _____ _____ (_____).

39. With shorter stimulus onset asynchrony (SOA), the reaction time to the (first/second) _____ stimulus becomes longer. The phenomenon is known as the _____ _____ period.

40. Pasher found that as he increased SOA, the reaction time to the second stimulus became _____, and the error rate became _____.

41. Pasher compared R2 reaction times following fast and not so fast responses to the first stimulus. He found that the faster the response to the first stimulus was made, the _____ the response to the second stimulus, especially when SOA was (long/short) _____. He interpreted these results as meaning that short SOA leads to a postponement of (stimulus indentification/response selection) _____.

42. A(n) _____ has occurred when the effects of one independent variable are not the same at each level of a second independent variable.

43. Wilkinson and Lee measured the amplitude of P200, and had their subjects count the number of times one of three tones was presented. They found an interaction between _____ _____ , a quasi-independent variable, and attended vs. unattended tones. The found the largest P200 component for _____ tones, and the difference between attended and unattended tones was greatest for recording sites located at the _____.

44. Lorig presented subjects with tones of two different pitches, and required them to count the number of times the (more/less) frequent tone was presented. This task is known as the _____ _____ task. While they were doing this, subjects were exposed to one of three concentrations of musk, no odor, below _____ _____, and an easily detectable concentration.

45. Lorig found that P200 amplitude was greater for the _____ tone, and tended to increase as the concentration of musk _____. An interaction between these two variables was found; for the _____ frequent tone. P200 amplitude increased with the musk concentration, while for the _____ frequent tone, P200 amplitude first increased and then decreased.

EXPERIMENTAL PROJECT

The Donders A (or simple) reaction task and the Donders B (or choice) reaction task can be easily demonstrated using very simple equipment. All you will need is a volunteer and two rulers of equal length. The basic task that your volunteer will be performing is the catch a ruler that is dropped by you. What we are interested in is seeing how long it takes to make a response (that is, to catch the ruler) in a simple and a choice reaction task.

Your measure of reaction time will be how far the ruler falls before your volunteer catches it. Hold the ruler above your volunteer's hand with the bottom of the ruler between the person's thumb and index finger. Tell the person to catch the ruler using only his or her thumb and index finger. On each trial. record where the person caught the ruler, using the top of the finger as the catch-point.

For the Donders A reaction you should use only one ruler. Give your volunteer a number of trials, and take the mean catch-point as an indication of his or her reaction time. Obtain reaction times for both the left and the right hand. The average of these two times will serve as the simple reaction time.

The Donders B reaction requires the use of two rulers, one for each of you subject's hands. On any trial, drop just one of the two rulers. After a number of right and left hand trials (switch between the hand in a random fashion) compute the mean reaction time for this choice reaction task.

How do your two reaction time values compare? Did the simple reaction task produce longer or shorter times than the choice task? How could you modify this demonstration so that you could include a Donders C reaction task? If this were an actual experiment, what possible control variables would you want to take into consideration?

EXPERIMENTAL DILEMMA

A researcher working for the Defense Department wanted to determine whether pilots or air traffic controllers were more affected by environmental stress.

Ten pilots and 10 air traffic controllers were selected for the experiment. Each subject looked at a computer monitor, and when a letter was presented, they were required to name the letter of the alphabet that came just before the presented letter, as quickly as they could. Subjects responded to 50 letters at each level of stress. Stress was manipulated by varying the level of the background noise between 10 (low stress) and 80 (high stress) dB. The dependent variable was the length of time required to name the target letter. All subjects were tested under both levels of stress, half the subjects in each group were tested with high stress first, and the others were tested first in the low stress condition.

The mean reaction times in msec. for each condition are shown in the following table:

	Stress Condition	
Subjects	Low Stress	High Stress
Pilots	1,500	2,300
Controllers	1,400	1,700

Statistical analysis revealed that reaction times in the high stress condition were significantly greater than those in the low stress condition, and that the effect of stress was significantly greater for pilots than it was for controllers.

What would you conclude from this experiment? Is there a way to improve the design of the study?

MULTIPLE CHOICE QUESTIONS

1. In Donders A (simple reaction) task there is _____ stimulus and _____ response.
   a. one; one
   b. one; more than one
   c. more than one; one
   d. more than one; more than one

2. In Donders B (choice reaction) task there is _____ stimulus and _____ response.
   a. one; one
   b. one; more than one
   c. more than one; one
   d. more than one; more than one

3 In Donders C reaction task there is _____ stimulus and _____ response.
   a. one; one
   b. one; more than one
   c. more than one; one
   d. more than one; more than one

4. When you are driving and approach a traffic light, you are faced with a _____ reaction situation
   a. simple
   b. choice
   c. C
   d. complex

5. Using Donders subtractive method for estimating the time required for mental operations, if you wanted to estimate how long stimulus identification takes, you would subtract _____ reaction time from _____ reaction time.
   a. A; B
   b. A; C
   c. B; C
   d. C; B

6. Using Donders subtractive method for estimating the time required for mental operations, if you wanted to estimate how long response selection takes, you would subtract _____ reaction time from _____ reaction time.
   a. A; B
   b. A; C
   c. B; C
   d. C; B

7. Donders subtractive method predicts that when the three kinds of reaction situations are ordered from fastest to slowest, the order would be:
   a. A, B, C
   b. B, A, C
   c. A, C, B
   d. C, A, B

8. A systematic way of examining one's own consciousness, used by Tichener is called
   a. interactionism
   b. introspection
   c. psychophysics
   d. psychophysiology

9. Psychophysiology uses _____ measures to understand _____ phenomena.
   a. physiological ; psychological
   b. psychological ; physiological
   c. physical; psychological
   d. physical ; physiological

10. Monitoring the electrical activity of the brain from scalp electrodes is called
   a. EKG
   b. EEG
   c. CAT
   d. DOG

11. In a relaxed awake subject, the EEG is likely to show many
   a. alpha waves.
   b. beta waves.
   c. ERPs.
   d. N400 components.

12. In a tense or tense subject, the EEG is likely to show many
   a. alpha waves.
   b. beta waves.
   c. ERPs.
   d. N400 components.

13. ERPs are
   a. seen in a state of relaxed wakefulness.
   b. seen in a state of heightened attention.
   c. brain events that are time locked to stimulus presentation.
   d. stimuli that are presented following certain brain events.

14. The ERP component that is associated with sensory processing of an auditory signal is the
    a. N100
    b. P200
    c. P300
    d. N400

15. The ERP component that is associated with paying attention to an auditory signal is the
    a. N100
    b. P200
    c. N300
    d. N400

16. The ERP component that occurs when an auditory signal is surprising is the
    a. N100
    b. P200
    c. P300
    d. N400

17. The key point in manipulating attention in an experiment is to
    a. make certain that the results obtained are not due to a speed-accuracy tradeoff.
    b. avoid ceiling and floor effects
    c. gradually increase the demands of a task until the subject has a hard time keeping up with them.
    d. make certain that the task does not impose a memory load sine this would confound memory and attention.

18. Confounding is a serious flaw in an experiment since it prevents the researcher from making
    a. statements about causation.
    b. interpretations about main effects.
    c. interpretations about interactions.
    d. all of the above

19. In a dichotic listening task subjects are
    a. presented with two different messages, one to each ear.
    b. required to respond as quickly as possible to an auditory event.
    c. required to count how often an infrequent auditory signal is presented
    d. required to detect the presence of an auditory signal in the presence of noise.

20. Gray and Wedderburn (1960) presented two messages to the two ears, alternating which ear a particular message went to after each syllable. They did this because in earlier work using the dichotic listening task
    a. channel and message were found to interact.
    b. memory and attention were found to interact.
    c. channel and message were confounded.
    d. memory and attention were confounded.

21. A common procedure in studies of dichotic listening is to require the listener to repeat aloud each word presented to one of the ears as it occurs. This task is called
    a. attending
    b. monitoring
    c. repeating the message aloud
    d. shadowing

22. Which of the following takes place in a shadowing task?
    a. a subject is asked to recall a list in the order of presentation
    b. a subject is asked to repeat each of a series of words as they are read to him or her.
    c. a subject is asked to rehearse a list in preparation for a memory test
    d. a subject is asked to detect a signal presented with noise.

23. A common procedure in studies of dichotic listening is to require the listener to repeat aloud each word presented to one of the ears as it occurs. This task is used to
    a. ensure that the subject correctly perceives each word.
    b. ensure that attention is devoted to the message that is repeated aloud.
    c. produce interference to prevent memory from being confounded with attention.
    d. all of the above.

24. There is a relationship between the speed and accuracy of performance. As speed _____, accuracy _____.
    a. increases; increases
    b. increases; decreases
    c. decreases, decreases
    d. there is no such simple relationship

25. Theios (1975) and Pachella (1974) investigated the effect of the probability that a stimulus would occur had upon reaction time and accuracy of performance in a digit naming task. The two experiments found that reaction time _____ , and error rate _____ as the probability of a stimulus increased.
    a. did not change; did not change
    b. did not change; decreased
    c. decreased; did not change
    d. decreased; decreased

26. The time between the presentation of two stimuli is called the
    a. delay
    b. reaction time
    c. silent period
    d. stimulus onset asynchrony (SOA)

27. Pashler (1989) used a modification of the choice reaction time task in which the SOA was varied between the presentation of the two stimuli. He found that with short SOAs the response to the _____ stimulus was _____.
    a. first; quickened
    b. first; delayed
    c. second; quickened
    d. second; delayed

28. The time following the presentation of a stimulus during which is it difficult to engage in additional cognitive activities is called the
    a. psychological refractory period.
    b. psychological shadowed period.
    c. physiological refractory period.
    d. physiological shadowed period.

29. An interaction can only occur when an experiment has
    a. at least one independent and one dependent variable.
    b. two or more independent variables
    c. two or more dependent variables
    d. two or more levels of an independent variable.

30. In an experiment an interaction occurs when
    a. confounding is present
    b. the effects of one independent variable are different at different levels of a second independent variable
    c. the effects of one independent variable are different for different dependent variables.
    d. two or more independent variable each have an independent effect on the dependent variable

31. Lorig (1991) used an auditory oddball task in an investigation of the effects of odor concentration. He reported an interaction between
    a. amplitude of the P200 component and odor concentration.
    b. amplitude of the P200 component and frequency of the sound stimulus.
    c. amplitude of the P200 component and recording site.
    d. odor concentration and frequency of the sound stimulus.

TRUE-FALSE QUESTIONS

____ 1. In a Donders B reaction task, there is only one stimulus but more than one response.

____ 2. Donders subtractive method is a technique used to estimate to time required for various mental operations.

____ 3. ERPs should be analyzed only when they are uncontaminated by preceding stimuli.

____ 4. In a dichotic listening task, shadowing may produce interference of memory processes necessary for the recall of the unshadowed message.

____ 5. Confounding is likely to be a problem whenever there are two dependent variables.

____ 6. A interaction occurs when each of two independent variables affect the dependent variable.

____ 7. Because of the speed-accuracy tradeoff, is it desirable to measure error rate as well as reaction times.

ESSAY QUESTIONS

1. Define an interaction.
2. What is meant by the speed-accuracy tradeoff? Under what conditions would it be especially important to consider both the error rate and the reaction time data?
3. Describe the logic behind Donders subtractive method.
4. Describe the confoundings that have contaminated early work in dichotic listening experiments, and tell how the confounded variables can be unconfounded.

Chapter 9

Conditioning and Learning

IN OTHER WORDS

Classical or **respondent conditioning**, discovered by Pavlov early in the twentieth century, is one of two basic forms conditioning. In classical conditioning a neutral or **conditioned stimulus (CS)**, i.e. one that does not initially elicit the response of interest, is systematically paired with an **unconditioned stimulus (US)** that does elicit the response of interest, called the **unconditioned response (UR)**. After a sufficient number of pairings, the CS elicits a response that is similar to the UR that is called the **conditioned response (CR)**.

Instrumental or **operant conditioning** occurs when organisms learn the consequences of their actions. Actions, for example a hungry rat's pressing a bar, that are followed by a reward, for example food, are reinforced, and are more likely to be repeated than unrewarded responses. Reinforcing stimuli strengthen the responses they follow. **Positive reinforcements**, like food for a hungry rat, are rewards - something good happens following the desired response. **Negative reinforcements** are aversive events, e.g. electric shock, that are terminated following the desired response. Aversive events that follow particular responses are called **punishments**, and they serve to lower the occurrence of the preceding action. Organisms can learn that certain **discriminative stimuli** can signal when their responses will result in reinforcement, and come to respond only when these stimuli are present.

In both classical and instrumental conditioning the relationship between the stimuli and responses are important. Kamin reported that in order for classical conditioning to occur, it is important for the US to be **contingent** on the CS, that is,

the CS must predict the occurrence of the US. Similarly in operant conditioning, rewards are effective in strengthening an action only if the occurrence of the reward is positively contingent on that action. If the contingency changes, behavior changes. If organisms learn that occurrence of the reinforcer is now independent of their behavior, a **null contingency**, they are likely to become lazy if the reinforcer is positive, and helpless is the reinforcer is negative. If the reinforcer is no longer presented at all, **experimental extinction** takes place, and the animal ceases to make the response. If the reinforcer follows only some occurrences of the response, experimental extinction is slowed, a phenomenon called the **partial reinforcement extinction effect**.

In all experimental research, a basic issue is whether to use every subject in each treatment condition of the experiment (a **within-subjects design**) or to use different groups of subjects in each condition (a **between-subjects design**). Sometimes different experimental results are obtained depending on which is used. The text cites an example of this: stimulus intensity had little effect on classical conditioning when manipulated between subjects, but a very large effect when manipulated within subjects. There are advantages and disadvantages associated with each design. In general, a within-subjects design is preferred unless the independent variable produces a relatively permanent change in behavior.

A within-subject design requires fewer subjects than a between-subjects design. Since the same subjects are used in every condition, differences between subjects are less likely to contaminate the experimental results, and consequently within-subjects designs are more efficient in detecting any differences between treatment conditions. The main disadvantage of within-subjects designs is that the experience of performing in one experimental condition may affect performance in a subsequent condition. This is known as the problem of **asymmetrical transfer** or **carryover effects**.

In within-subject designs each subject is usually tested over a long period of time. This passage of time might cause performance to deteriorate, a **fatigue effect**, or to improve due to practice on the experimental task, a **practice effect**. Care should be taken to ensure that fatigue and practice effects do not influence performance in some treatment conditions more than others. To accomplish this **counterbalancing** is used; different orderings of the treatments are given to different subjects. If there are only two treatment conditions, A and B, an **ABBA design** might be used for this purpose; it would be even better to test half the subjects in a BAAB order. With more than two treatment conditions, a **balanced Latin square design** is a good counterbalancing technique. Balanced Latin squares ensure that each

treatment is tested equally often at each stage of practice, and that each treatment both precedes and follows every other treatment the same number of times.

Counterbalancing can be used for other purposes than to control the order of treatment conditions in within-subject designs. The text describes an experiment by Bower on the effects of magnitude of reward on running speed. Some rats received only a large reward, some received only a small reward, and other rats received both large and small rewards on different trials, in alleys of different colors. Counterbalancing was used to control any effect that the color of the alley might have, and to control the sequence of large and small reward trials. Bower found a **simultaneous contrast** effect; the magnitude of the reward made more of a difference for rats that receive both levels of reward, than it did for rats that received only one level. In particular, a **negative contrast** was found. Rats that received both levels of reward ran more slowly for the small reward than did rats that received only the small reward. A **positive contrast effect** was not found, possibly because of ceiling effects.

In between-subjects designs the most serious disadvantage is that the equivalence of the different groups of subjects can not be determined. Since different subjects are tested in each condition, any difference between the groups is confounded with the differences between treatments. One way of minimizing this problem is to use a **random-groups design** in which individual subjects are randomly assigned to the various treatment conditions. The larger the number of subjects, the more likely it is that random assignment will result in equivalent groups.

Matched-groups designs seeks to introduce some of the advantages of within-subjects designs to a between groups comparison. Subjects are matched on relevant variables, and then randomly assigned to the different treatment conditions. The **split-litter technique** is a matching technique in which genetically similar litter mates are assigned to different groups. Matching on relevant variables can help reduce the variability that would result from a random-groups design.

Both between- and within-subjects designs require relatively large numbers of subjects so that an unusual subject does not distort the experimental results. Such designs are called **large-*n* designs**, and are the norm in psychological research. Some psychologists, who are interested in the experimental control of behavior in terms of operant conditioning, have adopted a different strategy. They use **small-*n* designs** which involves intensive analysis of a very few subjects. Small-n designs are especially useful in clinical situations. The **AB design**, which is flawed, compares several observations of behavior before (A) and after (B) a treatment is introduced. The problem with the AB design is that any change in behavior that occurs during

the B phase may have resulted other changes that occurred at about the same time that the treatment was introduced. The **ABA (reversal) design** is an improvement over the AB design because the return to the baseline conditions helps to rule out the possibility that some confounding factor was responsible for any behavioral change observed in the B phase. The logic of small-*n* designs has been extended to the **ABAB design**, which includes a second treatment phase, and to the **multiple baseline design** which is appropriate when the treatment produces permanent carryover effects. In the multiple baseline design, different behaviors, or different people receive baseline periods of varying length prior to the introduction of the treatment.

KEYWORD MATCHING

1.

_____classical conditioning
_____instrumental conditioning
_____operant conditioning
_____respondent conditioning

A. another name for classical conditioning
B. another name for instrumental conditioning
C. a neutral stimulus comes to elicit a response
D. changing the probability that a response will happen through reinforcement

2.

_____AB design
_____ABA design
_____ABAB design
_____ABBA design
_____balanced Latin square design
_____between-subjects design
_____large-*n* design
_____matched groups design
_____multiple baseline design
_____random-groups design
_____small-*n* design
_____within-subjects design

A. also known as a reversal design
B. between-subjects design where subjects are randomly assigned to experimental treatments
C. conventional between- and within-subject designs
D. design used for counterbalancing when there are two treatments
E. design used for counterbalancing when there are more than two treatments
F. each subject is tested in every experimental condition
G. extensive observations of one or a few subjects often used in clinical applications
H. different groups of subjects are tested in each treatment condition
I. faulty small-*n* design that does not control for confounding
J. sets of similar subjects are identified, and members of each set are assigned to different treatments
K. small-*n* design used to study different behaviors at the same time
L. small-*n* design with a return to the treatment condition following a second period of baseline observations

3.

_____carryover effect
_____fatigue effect
_____negative contrast effect
_____partial reinforcement extinction effect
_____positive contrast effect
_____practice effect

A. occurs when performance in one treatment condition is influenced by prior experience with another treatment
B. improvement of performance due to the time spent in the experiment
C. performance for large rewards is better if animal has also been exposed to small rewards
D. performance for small rewards is worse if animal has also been exposed to large rewards
E. responses that have been intermittently rewarded are slower to extinguish
F. worsening of performance due to the passage of time

4.

_____conditioned response (CR)
_____conditioned stimulus (CS)
_____discriminative stimulus
_____negative reinforcing stimulus
_____positive reinforcing stimulus
_____unconditioned response (UR)
_____unconditioned stimulus (US)

A. food pellets presented after a bar is pressed
B. salivation to a tone
C. salivation to food
D. sight of food
E. signal that actions will be rewarded
F. termination of an electric shock
G. tone or other neutral stimulus

5.

_____asymmetrical transfer
_____contingency
_____counterbalancing
_____experimental extinction
_____null contingency
_____punishment
_____simultaneous contrast
_____split-litter technique

A. another name for carryover effect
B. arrangement of experimental conditions to reduce confounding
C. effect of magnitude of reward is greater in within- than in between-subjects experiments
D. following a response with an aversive stimulus
E. can lead to laziness or helplessness in instrumental conditioning
F. relationship between CS and US in classical conditioning
G. used to produce genetically similar subjects in each treatment
H. weakening of an unrewarded response

PROGRAMMED REVIEW

1. The Russian physiologist who discovered classical conditioning was _____.
2. In a classical conditioning experiment food or electric shock would be called a(n) _____ _____.
3. In classical conditioning the unconditioned stimulus comes (before/after) _____ the response occurs.
4. After classical conditioning is completed, the previously neutral stimulus is now called the _____ stimulus.
5. When the conditioned stimulus is presented to the subject a(n) _____ _____ is elicited.
6. Another name for classical or Pavlovian conditioning is _____ conditioning.
7. Kamin showed that it is important that the conditioned stimulus _____ the unconditioned stimulus.
8. Another name for instrumental conditioning is _____ conditioning.

9. In an instrumental conditioning experiment, after the response is made, _____ is given to the learner.
10. The primary datum of interest in an instrumental conditioning experiment is the _____ with which some response occurs.
11. The two main classes of reinforcing stimuli are _____ and _____ reinforcers.
12. _____ is following a behavior with an aversive event.
13. The procedure of reinforcing closer and closer approximations to the desired behavior is called _____ the behavior.
14. A _____ stimulus is one that tells the organism when a response will be reinforced.
15. A organism that responds correctly and consistently in the presence of a discriminative stimulus and not in its absence is said to be under _____ _____.
16. The procedure of withholding a reinforcer after an organism makes a previously learned response is known as experimental _____.
17. When a reinforcer is given independently of the learner's behavior, this is known as a(n) _____ contingency.
18. In animal learning research, an important dependent variable that can be plotted over time is the _____ of _____.
19. The reciprocal of latency is _____.
20. A commonly used derived measure of learning is _____ to extinction.
21. By varying the amount of time that the organism has been deprived of the reinforcing stimulus (e.g., food, water) the researcher can vary the _____ level of the organism.
22. _____ refers to a temporary elevation in the amplitude of the conditioned response that is not due to an association between the CS and the US.
23. In a _____-_____ design, different groups of subjects are assigned to each level of the independent variable.

24. With a between-subjects design, the assignment of subjects to conditions should be done on a _____ basis.

25. There are two major drawbacks to between-subjects designs. First the number of _____ required may be very large. Second, the amount of _____ may be greater in a between-subjects design than in a within-subjects design.

26. In a _____-subjects design, it is possible to estimate statistically the variability that is due to subjects.

27. One problem associated with a within-subjects design is that performing in one condition may affect the subject's performance in another condition. This is knows as _____ transfer or a _____ effect.

28. Two primary factors to be considered in a within-subjects design are _____ effects, which refer to subjects performing better in the experimental task as a results of experience with the task, and _____ effects which refer to decreases in performance levels over the course of the experiment.

29. The process of systematically varying the order in which conditions are presented to subjects is known as _____ of conditions.

30. In a _____-groups design, subjects in different conditions are matched on relevant variables. This is done to help reduce the _____ among the groups.

31. The _____-litter technique involves taking animals from the same litter and randomly assigning then to different groups.

32. Eyelid conditioning is an example of _____ or _____ conditioning.

33. In eyelid conditioning, the unconditioned stimulus (US) is the _____, the conditioned stimulus (CS) is the _____, and the unconditioned response (UR) is the _____.

34. In Bower's (1961) experiment, rats that received both small and large rewards ran (faster/slower) _____ in the small reward trial than the rats that received only small rewards. This is called a _____ _____ effect.

35. One counterbalancing technique that is effective when there are only two conditions being tested is to use a(n) _____ design.

36. In a balanced _____ _____ design, each condition is preceded and followed equally often by every other condition.

37. In an AB design, A represents the _____ condition and B represents the condition after the _____ variable, or treatment, has been introduced.

38. The AB design is a poor design because whatever changes occur during the _____ phase may be due to some other factor confounded with the _____ variable of interest.

39. One solution to the problem associated with the AB design is to return to the original baseline condition, using a _____ or _____ design to see if the behavior returns to the base rate.

40. In a large-*n* design, the *n* is the designation for the number of _____.

41. Most small-*n* designs are _____-subject designs.

42. _____ _____ designs can be used to monitor several different behaviors, or several different subject at the same time.

43. The _____ _____ _____ effect refers to the fact that infrequent reinforcement will lead to greater persistence in responding than will continuous reinforcement.

EXPERIMENTAL PROJECT

The principles of operant conditioning are functioning in many ways in our everyday lives. For example, pet owners often apply the principles of operant conditioning when attempting to train their pets. In this project you will have an opportunity to try to apply these principles in conditioning another human's behavior. This project is essentially a partial replication of a study reported by Verplanck (1955).

If attention from another person in reinforcing, then it should be possible to use attention as a reinforcer for increasing the frequency of some response. In this demonstration project a "point" system will be use to reinforce another person's behavior. The goal of this conditioning exercise is to increase the frequency with which a person makes opinionated statements.

The experiment requires one person to serve as a volunteer subject. The only materials needed are two sheets of paper, two pencils, and a watch or clock suitable for timing one minute intervals.

The experiment should be carried out in a quite room in which the experiment can proceed uninterrupted for one hour. Once the experimenter and the subject are seated, the experimenter should read the following instructions to the subject.

> **In a moment I want you to begin talking. You are free to talk about whatever topic you want. I will not be saying anything during the experiment, but do not let this silence bother you. your task in the experiment is to work for points. You will receive a point each time I tap my pencil. As soon as you receive a point, record it on your score sheet by making a tally mark. Do you have any questions?**

(At this point you should answer any questions the subject may have)

> **If you have no (further) questions, please begin talking.**

Each time you subject makes an opinionated statement, tap your pencil to give your subject a point. You will have to decide what constitutes an opinionated statement, but reinforce such statements as "I believe that...", "I feel that...", "I think that...", etc.

The experiment will consist of an acquisition phase and an extinction phase. During each of these phases, you will keep track of the number of opinionated statements made by the subject during each minute. During the first 18 minutes, you should tap your pencil every time an opinionated statement is made. After the first 18 minutes, you should stop "giving points" and simply keep track of how many opinionated statements are made during each of the next 18 minutes.

After the experiment is completed, find out if your subject was aware of what (s)he was doing to receive points.

Prepare an appropriate graph of your results, with time in minutes on the X axis, and number of opinionated statements on the Y axis. Was operant conditioning demonstrated? Was there a difference in the number of opinionated statements made during the acquisition and extinction phases? Do you think that operant conditioning could be applied to other aspect of human behavior?

REFERENCE:

Verplanck, W.S. (1955) The operant, from rat to man: An introduction to some recent experiments on human behavior. *Transactions of the New York Academy of Science, 17*, 594-601.

EXPERIMENTAL DILEMMA

An experimental psychologist wanted to know whether it is easier for pigeons to make color discriminations (blue vs. yellow) or intensity discriminations (dim vs. bright). In order to minimize differences in learning rate, he decided to use a within-subjects design. The pigeons had previously been trained to peck a key in the experimental chamber in order to receive a reward. During the discrimination training phase a second key in the chamber was illuminated with either a yellow light, a blue light a dim red light, or a bright red light. For half the subjects the yellow light was the discriminative stimulus (i.e. when the yellow light was on, key pecks were rewarded), while for the other half of the subjects the blue light was the discriminative stimulus. Also, for half of each of these groups, the bright red light was the discriminative stimulus, and for the remaining half the dim red light was the discriminative stimulus. Thus there were four groups of subjects, defined by which stimuli were the discriminative stimuli (yellow & dim red, yellow & bright red, blue & dim red, and blue & bright red).

During each minute of the experimental session, one of the four stimuli was presented on the second key in the test chamber. If the stimulus was a discriminative stimulus. the pigeon was rewarded for key pecks, if not, then key pecks were not rewarded. The order of the four stimuli was random, and during each one hour session each stimulus appeared during 15 1-minute intervals.

The dependent variable was the number of training trials on a dimension (Color or Brightness) needed to reach a criterion of five consecutive trials each with less than three responses to the nonrewarded stimulus on that dimension. For example, if for pigeon #1 blue was the discriminative stimulus, then the pigeon reached criterion when there were five consecutive yellow trials in which three or fewer responses were made.

The results showed that there was no overall effect of the four different combinations of the discriminative stimuli. However, for all four groups, the color discrimination was learned faster than the brightness discrimination. The researcher concluded that pigeons learn color discriminations faster than they learn brightness discriminations.

Is this conclusion valid? Is your conclusion the same as, or different from the researcher's?

MULTIPLE CHOICE QUESTIONS

1. Pavlov is credited with discovering
   a. operant conditioning.
   b. classical conditioning.
   c. instrumental conditioning.
   d. all of the above

2. Another name for instrumental conditioning is _____ conditioning, and another name for Pavlovian conditioning is _____ conditioning.
   a. respondent; classical
   b. classical, respondent
   c. reflex; operant
   d. operant; respondent
   e. operant; reflex

3. Consider an experiment in which a bell is paired with a painful electrical shock to the foot of a dog. When the shock is presented, the dog reflexively withdraws its paw. after several bell-shock pairings, the dog withdraws its paw when the bell is presented alone. Before the pairings, the bell would be considered a(n) _____ stimulus.
   a. conditioned
   b. neutral
   c. discriminative
   d. unconditioned

4. Consider an experiment in which a bell is paired with a painful electrical shock to the foot of a dog. When the shock is presented, the dog reflexively withdraws its paw. after several bell-shock pairings, the dog withdraws its paw when the bell is presented alone. The shock would be considered a(n) _____ stimulus.
   a. conditioned
   b. neutral
   c. discriminative
   d. unconditioned

5. Consider an experiment in which a bell is paired with a painful electrical shock to the foot of a dog. When the shock is presented, the dog reflexively withdraws its paw. after several bell-shock pairings, the dog withdraws its paw when the bell is presented alone. The learned response to the bell would be considered a(n) _____ response.
   a. conditioned
   b. automatic reflex
   c. instrumental
   d. unconditioned

6. In order for classical conditioning to occur it is important that the CS
   a. be rewarding.
   b. predict the US.
   c. follow the US.
   d. be stronger than the US.

7. Which principle underlies operant conditioning?
   a. instrumental conditioning
   b. Law of Effect
   c. Law of Use
   d. response generalization

8. The primary datum of interest in operant conditioning is the
   a. amplitude of the response.
   b. approximation of the response to the desired response.
   c. within-subject response variability.
   d. rate at which the response occurs.

9. If an animal is rewarded for responding when a light in the test chamber is turned on, and is not rewarded for responding when the light is turned off, then the light is called a(n)
   a. environmental reinforcing cue.
   b. response-contingent stimulus.
   c. discriminative stimulus.
   d. conditioned stimulus.

10. Which of the following independent variables may be used in either classical or instrumental conditioning?
   a. reinforcement schedules
   b. delay of time between response and reinforcement
   c. magnitude of reinforcement
   d. all of the above

11. All of the following are basic measures of learning **except**
    a. response speed
    b. resistance to extinction
    c. magnitude of the response
    d. rate of response

12. The phenomenon of pseudoconditioning refers to
    a. a temporary elevation in the amplitude to the conditioned response that is not due to an association between the CS and US.
    b. a temporary elevation in the amplitude to the conditioned response that is due to an association between the CS and US.
    c. the organism being conditioned to an uncontrolled stimulus in the learning environment.
    d. conditioning that results from a chance confounding of the CR and UR.

13. A control groups is given the same number of CS and US presentations as a conditioning groups of subjects, except that in the control groups the CS and US are unpaired and randomly presented. This control groups is included in the experiment to control for
    a. response generalization.
    b. pseudoconditioning.
    c. differences in reinforcement schedules.
    d. varying the delay of reinforcement.

14. A researcher states that his experimental design is more sensitive than an alternative design, since with his design he can estimate statistically what portion of the total variance is due to subjects. This experimenter used a
    a. between-subjects design
    b. within-subjects design
    c. small-*n* design
    d. random groups design

15. The advantages(s) of using a within-subjects design is (are) that
    a. treatment order effects are avoided
    b. fewer subjects are required
    c. the variability due to subjects can be estimated statistically
    d. *a* and *c*
    e. *b* and *c*

16. A matched-groups design attempts to
    a. reduce between-group subject variability.
    b. reduce between-group differences on the dependent variable.
    c. reduce within-group subject variability.
    d. both *a* and *c*

17. In an ABA design for a clinical therapy study, the third A phase is included to
    a. extinguish the problem behavior learned in the B phase.
    b. reinforce normal behavior learned in the B phase.
    c. allow the conclusion that it was the independent variable that produced the behavioral change.
    d. all of the above
    e. both *a* and *c*

18. The partial reinforcement extinction effect is a phenomenon in which partial reinforcement schedules produce learning that
    a. extinguishes more rapidly than learning under continuous reinforcement.
    b. extinguishes at the same rate as learning under continuous reinforcement.
    c. extinguishes more slowly than learning under continuous reinforcement.
    d. is simultaneously classically and instrumentally conditioned.

19. In Bower's experiment in simultaneous contrast, the negative contrast effect he obtained refers to the finding that rats that received both large and small rewards ran
    a. just as fast for the small rewards as rats that received only the small rewards.
    b. faster for the small rewards than rats that received only the small rewards.
    c. slower for the small rewards than rats that received only the small rewards.
    d. faster for the large rewards than rats that received only the large rewards.

20. Which of the following features is (are) true for a balanced Latin square and is (are) not true for other counterbalancing scheme?
    a. each treatment condition occurs, on the average, at the same stage of practice.
    b. each condition is presented to subjects equally often.
    c. each condition precedes and follows every other condition equally often.
    d. all of the above
    e. none of the above

TRUE-FALSE QUESTIONS

_____ 1. In classical or Pavlovian conditioning, the stimulus that produces the unconditioned response is called the conditioned stimulus.

_____ 2. The Law of Effect states that if an organism makes an operant response and if that response is followed by a reinforcing stimulus, then the probability that the response will occur again is increased.

_____ 3. When subjects are randomly assigned to conditions in a within-subjects design, this is referred to as a random-groups design.

_____ 4. The two primary problems associated with between-subjects designs are that they require a lot of subjects, and that the variability due to subject differences cannot be estimated statistically and taken into account.

_____ 5. Within-subject designs are inappropriate in cases where performing in one condition is likely to change performance in another condition, and in cases where subjects may figure out what is expected of them in the experiment.

_____ 6. If there are an odd number of treatment conditions in an experiment, then two balanced Latin squares are required to completely counterbalance the treatment conditions.

_____ 7. The matched-groups design attempts to introduce some of the advantages of a within-subjects design to a between-subjects design by attempting to reduce the variability among observations between groups due to subject differences.If an experimenter is concerned with the problem of large effects of early practice in training, then an appropriate counterbalancing scheme to avoid this problem would be an ABBA design, because with this type of design on the average each condition would be tested at the same time.

_____ 8. Asymmetrical transfer, or carryover effects, refer to cases in which performing in one condition is likely to change performance in another condition.

ESSAY QUESTIONS

1. Describe the procedures employed in a Pavlovian conditioning experiment. Use an example to illustrate your answer, and be sure to use appropriate terminology (e.g., CS, US, etc.) whenever possible.
2. What is pseudoconditioning? Describe an appropriate control for pseudoconditioning, using a hypothetical experiment to illustrate your answer.
3. Compare and contrast the AB and the ABA designs. Suggest a study in which the ABA might be used, and one which a multiple baseline design would be appropriate.

Chapter 10

Remembering and Forgetting

IN OTHER WORDS

The first psychologist to make significant progress in the study of memory was Hermann Ebbinghaus. He devised special materials to be remembered that were free from previous associations, called **nonsense syllables**, and were made up of two consonants separated by a vowel. Ebbinghaus would study a list of nonsense syllables in a standardized way, and would note the number of trials it took to repeat the list in order. This measure, called **trials to criterion**, was an index of the difficulty of the list. After an appropriate time had passed, he measured his retention of this list by relearning it to the same criterion, and comparing the number of trials required for learning and relearning the list. Ebbinghaus devised the **savings method** to measure the memory of the list; he calculated the percent reduction in the number of trials to criterion from original learning to relearning. By using this method, Ebbinghaus found that forgetting occurred rapidly right after original learning, and more slowly as the retention interval increased.

Ebbinghaus studied what today is called **long-term memory**, the retrieval of information after it has left conscious awareness. Within long term memory, modern psychologists distinguish between explicit memory and implicit memory. **Explicit memory** (also called **episodic memory**) refers to the conscious recollection of events in one's life and of knowledge learned in the past. **Implicit memory** refers to the influence of past experience on current behavior, without a conscious effort to retrieve that experience. Psychologists are also interested in **short-term memory**, the maintenance and recovery of recently presented information.

Measures of memory performance used today primarily involve recall and recognition. In **recall** tests, reproduction of the remembered material is required, while in **recognition** tests subjects are required to select items they have previously seen. Several types of recall task are commonly used: **serial recall** involves the production of a list of items in the order in which they were presented for study, **free recall** allows the subject to report the items in any order they wish, and **paired-associate recall** involves producing an item after being shown the item it was paired with during study. The **Brown-Peterson technique** is a serial recall task that is used to study short-term memory. Subjects are given information to remember for short periods of time, but are prevented from rehearsing the information by being required to engage in some other task during the retention interval. In the **yes/no recognition task**, subjects are shown one item at a time that is either an originally studied item or a new item. Subjects are asked to indicate which items were in the original list. The **forced-choice recognition task** is preferred to the yes/no task, and requires the subject to chose the one previously studied item from a group of items.

One problem encountered in memory research is that of **scale attenuation**. This occurs when performance on a task approaches either end of the scale of measurement. A **ceiling effect** occurs when performance is nearly perfect, and a **floor effect** refers to low levels of performance. It is inappropriate to say that performance is equal in two conditions when performance levels reflect scale attenuation effects since we have no way of knowing how the two groups might compare if we were able to bring performance levels up or down within the confines of the dependent measure. The problem of scale attenuation was illustrated in an study reported by Scarborough, who measured short-term retention of visually and auditorially presented material at several intervals. Scarborough found that visually presented material was better retrained than auditorially presented material. But because performance was nearly identical at the 0 sec. retention interval (a ceiling effect), it could not be concluded that the rate of forgetting was different for the two modalities.

A problem that occurs throughout experimental psychology is whether the results obtained in one study would be obtained in other situations, i.e. **the generality of results**. Jenkins in his **tetrahedral model of memory experiments** has identified four dimensions in which the generality of results might be assessed in memory research. These dimensions are subject populations, materials to be remembered, type of memory test, and orienting tasks and experimental settings.

The chapter reviewed several studies on the levels of processing approach to memory that deal with the issues of generality of results. The **levels of processing**

approach suggests that stimuli can be processed at several levels which differ in "depth", and that the more deeply a stimulus is processed, the more likely it is to be remembered. For example, asking a subject questions about the letters in a word encourage a **graphemic encoding** of the stimulus, which is shallow. A deeper level of processing is involved when the words must be processed in terms of its sounds, a **phonemic encoding**. A still deeper level is achieved when the subject is required to answer a question about the meaning of the word which involves **semantic encoding** of the stimulus. Various studies have shown that the levels of processing effects generalize well over subject populations including college students, the elderly, children, and Korsakoff's patients. The effects have been found with verbal materials, pictures, and photographs of faces. With respect to the orienting tasks, the levels of processing effect have been found in both intentional and incidental learning, and with a wide variety of different tasks that encourage shallow or deep processing. Although the effect generalizes to many recall and recognition memory tests, there are some memory tests in which the levels of processing effect does not occur. What seems to be important is whether the subject's task in remembering more closely matches the deep processing or the shallow processing the subject engaged in during the original study, an idea called **transfer appropriate processing**.

Experiments involving more than one independent variable are called multifactor experiments. Such experiments allow the researcher to determine simultaneously whether each independent variable has an overall effect (a **main effect**) on the dependent variable. In addition, multifactor experiments also allow researchers to discover **interactions** between the independent variables, that is, whether the effect of one independent variable is the same at each level of another independent variable. Interactions are not limited to two independent variables. If the interaction between two independent variables is not the same at each level of a third independent variable, a **higher-order interaction** has occurred. In this chapter, interactions are considered in a consideration of implicit and explicit memory tests.

Amnesia is a severe memory disorder that results from brain damage. It has long been recognized that amnesics are impaired on explicit memory tasks, often dramatically so. An important study by Warrington and Weiskrantz (1970) showed that amnesics are able to show normal performance on an implicit memory task. Implicit memory is often studied by exposing subjects to materials (**priming**) without asking the subjects to remember them. Performance on appropriate subsequent tasks, such as the **word-fragment completion task**, is influenced by the prior priming stimuli. So, an interaction was found between a subject variable (amnesic vs. control) and memory test type (explicit vs. implicit) on memory performance.

Amnesics had much lower memory performance on the explicit task, but did not differ from controls in the implicit task.

Another interaction was found in a study by Weldon and Roediger (1987) which manipulated the memory task (explicit free recall test vs. implicit word fragment completion test) and the nature of the prime (picture vs. words). They found that picture primes were better remembered than word primes on the free recall test (the picture superiority effect), but the that word primes were better remembered than the pictures on the word fragment completion task. This kind of interaction is called a **crossover interaction** which means that one independent variable has an opposite effect on behavior at the two levels of the second independent variable.

The chapter concludes with a discussion of memory aids, called **mnemonic devices**, which are procedures that encourage the successful storage and retrieval of information. Using the **method of loci** involves forming a image of a to-be-remembered item in a particular location along a familiar route. The **peg-word method** requires the user to first memorize a list of peg words that rhyme with numbers ("one is a bun, two is a shoe," etc.). When presented with words to be remembered, the user forms an interactive image of the first word with a bun, and each successive item with the next peg word. Use of these mnemonic devices is likely to be more efficient and require less effort than rote rehearsal of the list of items.

KEYWORD MATCHING

1.

___episodic memory
___explicit memory
___implicit memory
___long-term memory
___short-term memory

A. another name for explicit memory
B. maintaining something in and retrieving something from consciousness
C. previous events influence present behavior, without conscious retrieval
D. remembering past events
E. remembering something after it has left consciousness

2.

___ Brown-Peterson technique
___ forced-choice recognition
___ free recall
___ paired-associate recall
___ recall
___ recognition
___ serial recall
___ word fragment completion task
___ yes/no recognition

A. recognizing previously studied material
B. recognizing whether a single item had been previously encountered
C. reproducing previously studied material
D. reproducing the items of a list in any order
E. reproducing the items of a list in the original order
F. reproducing the "partner" of a displayed item
G. selecting the one item from a group that has been previously seen
H. used to study implicit memory
I. used to study short-term memory, rehearsal is prevented

3.

___ crossover interaction
___ higher-order interaction
___ interaction

A. levels of an independent variable produce opposite effects on behavior depending on which level of a second independent variable they are paired with
B. the effect of one independent variable is exactly the same for every level of another independent variable
C. the effect of one independent variable is not the same for every level of another independent variable
D. the interaction between two independent variables is not the same for every level of another independent variable

4.

A ceiling effect
B floor effect
E main effect
D scale attenuation effect

A. performance in one or more conditions of an experiment is near the maximum measurable value
B. performance in one or more conditions of an experiment is near the minimum measurable value
C. restriction of the range over which the independent variable can be manipulated
D. restriction of the range over which the dependent variable can be measured
E. the overall behavioral differences between the levels of an independent variable

5.

B method of loci
C mnemonic devices
R peg-word method
A savings method

A. Ebbinghaus' measurement of retention
B. items are imaged along a familiar path
C. memory aids
D. "One is a bun"

6.

D amnesia
B priming
A proactive interference

A. early experience inhibits the recall of recent material
B. introducing material in the study of implicit memory
C. recent material inhibits the recall of early experience
D. severe explicit memory loss resulting from brain damage

7.

B generality of results
G graphemic code
C levels of processing
H nonsense syllables
F phonemic code
E semantic code
D tetrahedral model
I transfer appropriate processing
A trials to criterion

A. Ebbinghaus' measure of list difficulty
B. extent to which research findings can be applied to other situations
C. idea that deeper processing of material facilitates subsequent recall
D. identifies four dimensions of memory experiments to be considered in establishing generality of results
E. level of processing associated with meaning
F. level of processing associated with the auditory propertied of a spoken word
G. low level of processing associated with the physical properties of the printed word
H. materials in Ebbinghaus' study of memory
I. memory performance is a joint function of the type of initial processing and the nature of the memory test

PROGRAMMED REVIEW

1. Robert Benchley's list of college memories is an example of Serial recall.
2. Ebbinghaus used nonsense Syllables as materials in his experiments.
3. Ebbinghaus measured Savings when trying to determine whether any unrecallable information had been retained.
4. Ebbinghaus found that forgetting is rapid soon after learning, but then it slows down as the Retention interval is increased.
5. Conscious recollection of events that occurred in your life required the use of Explicit memory, whereas Implicit expressions of memory do not require you to consciously retrieve information acquired in the past.
6. Three popular types of recall tests are Serial recall; Free recall, and Paired - associate recall.
7. Two types of recognition tests used by memory researchers are Forced choice and Yes/No recognition

8. Memory tasks in which the subject is not requires to consciously recollect previously experienced events are called implicit memory tests.

9. When performance is near either the top or the bottom of the measurement scale, Scale Attenuation effect may have occurred.

10. Ceiling effects are observed when performance is almost perfect, and Floor effects are observed when performance is extremely low.

11. The Brown - Peterson technique uses a distracter task in which subjects count backwards by threes during the retention interval.

12. Proactive interference occurs when information learned on early trials interferes with recall on later trials.

13. Scarborough found that recall was higher with Visual presentation than with Auditory presentation.

14. Researchers often test small groups of Pilot subjects in order to discover possible ceiling and floor effects.

15. When a conclusion drawn from one experimental situation cannot be extended to another setting, the experiment lacks Generality of results.

16. According to the levels of processing approach, memory can be viewed as a by-product of Perception.

17. The four critical dimensions identified in Jenkins' tetrahedral model of memory experiments are Subjects, Orienting tasks, Materials, and Test [illegible].

18. The transfer appropriate processing view maintains that performance on a memory test will benefit most when the cognitive operations performed during Study match those required by the Test.

19. Multifactor experiments are those in which more than one independent variable is manipulated simultaneously.

20. A(n) interaction occurs when the effect of one independent variable changes depending one the level of another independent variable.

21. Tests that require a person to consciously recollect previously studied materials are called Explicit memory tasks.

22. Presenting a person with T_B_E and asking them to fill in the blanks so as to come up with a word is an example of a(n) implicit memory test.

23. The improvement in word fragment completion test performance seen when a person had previously studied the target words is known as priming.

24. Amnesic patients do worse that control subject on (explicit/implicit) explicit memory tests.

25. When the effect of one variable changes at different levels of another variable, the two variables are said to interact with one another.

26. If the results of an experiment show that Group A does better than Group B on Test 1, but the opposite is observed on Test 2, a(n) crossover interaction has occurred.

27. Warrington and Weiskrantz found that amnesics do worse than control subjects on a(n) word fragment test.

28. Results of may experiments show that amnesics do worse than control subjects on explicit memory tasks, but may do just as well as control subjects on implicit memory tasks.

29. One must be particularly careful when interpreting interaction effects that may be caused by either ceiling or floor effects.

30. One of the easiest ways to detect an interaction in a set of data is to graph the data.

31. When the independent variable used in an experiment is categorical (e.g., memory for nouns vs. memory for verbs), the results should be presented using a bar graph.

32. The appropriate use of line graphs require that the independent variable is (at least) a(n) ordinal scale variable.

EXPERIMENTAL PROJECT

Some memory researchers have found that information is better remembered when the presentations of study material are spaced apart from one another than when they are massed together. That is, you will probably do better on an exam if you study the material periodically throughout the course than if you just cram the night before the test. As an illustration of this general principle, conduct a study in which you manipulate spaced vs. massed practice as one of your independent variables. In order to better understand the concept of multifactor designs, add another manipulation of type of study material, namely whether the study words occur with low or high frequency in everyday language. (Lists of low and high

frequency words may be obtained from the Kucera and Francis word norms found in *Computational analysis of present-day American English.* Providence RI: Brown University Press, 1967). Manipulate spaced vs. massed presentation rates between subjects, and vary word frequency as a within-subject factor.

The study material for all subjects will consist of a 100 word list - half of the words should be high frequency and half should be low frequency words. Test the same number of subjects in the spaced and massed groups, and equate the total study time across the two groups. Subjects in the spaced group should be given the list of words to study for 5 minutes on three separate occasions prior to the test. The time between presentations should be the same for all subjects in the group. Give a 10 minute free recall test immediately following the third presentation. Give the massed group the stimulus list and have them study it for 15 minutes. Following study, test them in exactly the same manner as the spaced group.

Score the data for a general measure of number of words recalled for the spaced vs. massed conditions, and for the number of high vs. low frequency words recalled. These measures will allow you to assess main effects. You will also need a breakdown of the number of high and low frequency words recalled in each study group in order to look at interaction effects. Plot the number of words recalled as a function of word frequency and study condition. Do you find any main effects? Is there an interaction? Do you have scale attenuation problems? What do these results suggest to you about your present study habits?

EXPERIMENTAL DILEMMA

An experimenter examined the effects of "test expectancy" (expected recall vs. expected recognition memory test) on performance of different types of tests (recall vs. recognition) as a function of the type of material to be learned. The study words were varied as to their imageability. High imagery words were whose for which subjects could readily form a mental image (e.g. *zebra*) and low imagery words were items for which mental images could not be easily formed (e.g. *experiment*). All these variables were manipulated between subjects. Thus the design was a 2 (test expectancy) X 2 (test type) X 2 (imagery) multifactor design. Subjects were given a 25 item word list to study overnight. Half the subjects were told that they would be given a recall test the next day, and the other were told that they would be give a recognition test. In addition, half the subjects studied low imagery words, and the others studied high imagery words. When they returned to the laboratory the next day, they were given a memory test; half of the subjects received the type of test they expected, and the others received the unexpected test

type. The following results were obtained. The numbers represent percent correct on the memory tests.

	Low Imagery Items		High Imagery Items	
	Test Given		Test Given	
Test Expected	Recall	Recognition	Recall	Recognition
Recall	70	75	99	99
Recognition	40	85	92	98

Statistical analysis revealed reliable main effects of test type, test expectancy, and imagery. There was a significant test type X expectancy interaction, and there was a significant three-way interaction of all the independent variables. The experimenter concluded that performance on recognition tests was superior to performance on recall tests, and that subjects performed better in general when they expected a recall test rather than a recognition test. He also argued that high imagery words were better remembered than low imagery words. Furthermore, performance was enhanced when the type of test given matched the type of test expected. With regard to the three way interaction, the experimenter concluded that when subjects study low imagery words, recognition performance is superior to recall when subjects expect recall, but that there is no such difference when high imagery words are studied.

Is there anything wrong with the design or the procedures? Are there any problems with the conclusions?

MULTIPLE CHOICE QUESTIONS

1. Robert Benchley's list of things he learned in college is an example of
   a. savings.
   b. free recall.
   c. serial recall.
   d. proactive interference.
2. Ebbinghaus used nonsense syllables in his experiments because
   a. CVCs are difficult to learn.
   b. it is easy to for associations between different nonsense syllables.
   c. savings is directly related to the trials to criterion measure.
   d. CVCs are free from past associations.

3. How might you determine whether any information about list items has been learned if a subject is unable to recall the information?
   a. Measure trials to criterion to relearn the list and compare it with the number of trials needed to learn the list the first time.
   b. Measure savings in learning the list a second time.
   c. If a subject cannot recall list items you should assume that the information has been forgotten.
   d. both *a* and *b*

4. Which of the following is **not** a type of recall memory test?
   a. free associate recall
   b. free recall
   c. paired associate recall
   d. serial recall

5. Of the types of tests used by memory researchers, _____ tests are most similar to multiple-choice tests.
   a. serial recall
   b. yes/no recognition
   c. forced choice recognition
   d. paired associate recognition

6. Remembering what you ate for breakfast require the use of _____ memory.
   a. explicit
   b. implicit
   c. short-term
   d. sensory

7. Which of the following is true?
   a. recall and recognition tests are dichotomous.
   b. Ebbinghaus' forgetting curve shows that the rate of forgetting is rapid soon after learning, but then slows.
   c. It has been shown that memory for previously learned information does not exist if there is no evidence of active retrieval.
   d. all of the above

8. A memory test in which subjects recall items in their order of presentation is called a _____ recall test.
   a. free
   b. paired associate
   c. sequential
   d. serial

9. The Brown-Peterson paradigm has which of the following features?
   a. an interpolated task during the retention interval
   b. a trials to criterion measure
   c. a savings measure
   d. all of the above

10. The phenomenon of proactive interference as exemplified in the Brown-Peterson paradigm refers to
   a. the effect of counting backwards during the retention interval.
   b. interference caused by a long retention interval.
   c. information from early trials interfering with recall on later trials.
   d. information from recent trials interfering with recall of early items.

11. Morris, Bransford, and Franks' (1977) found that on a recognition task that required the use of phonemic knowledge, phonemic encoding processes produced the best performance. This finding is most consistent with
   a. levels of processing
   b. transfer appropriate processing
   c. explicit memory
   d. implicit memory

12. Which of the following is **not** one of the factors included in Jenkins' tetrahedral model of memory experiments?
   a. materials
   b. retention intervals
   c. subjects
   d. tests

13. Scale attenuation effects are observed when
   a. subjects fail to show savings from one learning trial to the next.
   b. the performance of every subject is above (or below) the average.
   c. performance is virtually perfect or virtually nonexistent.
   d. recency effects are larger than primacy effects.

14. Researcher Q found that recall was better for visually presented than for auditorially presented material. Researcher P found just the opposite. These results illustrate
   a. failure of generality.
   b. experimental confounding.
   c. transfer appropriate processing.
   d. an interaction.

15. Each of the following is an explicit memory test **except**
    a. free recall of studied words.
    b. recall of category items.
    c. recognition of studied pictures.
    d. word fragment completion.

16. In a word fragment completion task, subjects solve 60% of the fragments corresponding to previously studied words and 40% of the fragments corresponding to nonstudied words. The priming score here would be
    a. 20%
    b. 40%
    c. 60%
    d. 100%

17. On which of the following would you expect an amnesic to perform at approximately the same level as a normal control subject?
    a. free recall
    b. serial recall
    c. word fragment completion
    d. recognition

18. When an independent variable has opposite effects on behavior at each level of a second independent variable we speak of a(n) _____ interaction.
    a. higher order
    b. X
    c. crossover
    d. explicit

19. An experimenter studied the effects of education level on soft drink preference. Both Ph.D.'s and high school graduates preferred Coke to Pepsi, but the effect was much larger for high school graduates than for Ph.D.'s The results suggest
    a. a main effect and an interaction.
    b. a main effect with no interaction.
    c. an interaction with no main effect.
    d. neither a main effect nor an interaction.

20. A higher order interaction refers to an interaction
    a. that is highly statistically significant.
    b. associated with more than one main effect.
    c. involving more than one dependent variable.
    d. involving more than two independent variables.

21. Which of the following independent variables would yield data that should be plotted in a bar graph?
    a. length of a list of words in a memory experiment
    b. type of food quality (sweet, sour) in a taste preference experiment
    c. brightness of a light in a signal detection task
    d. frequency of a tone is an auditory recognition task

22. Which of the following scale types should **not** be plotted using a line graph?
    a. nominal
    b. ordinal
    c. interval
    d. ratio

TRUE-FALSE QUESTIONS

F 1. Ebbinghaus used CVC as stimuli in order to equate the length of items in his lists.

T 2. If you try to learn material for a second time, chances are that you will experience savings.

T 3. By using the savings method, Ebbinghaus was able to find evidence that unrecalled information was still retained.

T 4. The primary difference between recall and recognition is that recall requires overt production, whereas recognition involves a familiarity judgment.

T 5. Performance drops after several trials in the Brown-Peterson task due to proactive interference.

F 6. Scarborough concluded that the rate of forgetting is greater for auditory than for visual presentation.

T 7. Scarborough showed that people who received input from both the auditory and visual modalities did no better at recall than those who received only visual input.

T 8. Scale attenuation effects can hide actual differences that may exist between experimental conditions.

F 9. Craik and Lockhart proposed a transfer appropriate processing model of memory.

F 10. According to the levels of processing framework, the more meaningful analysis an item undergoes during encoding, the better a person's memory for that item will be.

T 11. A science progresses, failures of results to generalize across some variable typically result in the data from these experiments being discarded.

F 12. A main effect occurs when the effect of one variable changes across levels of another variable.

F 13. Interactions tell us that the effect of one variable is the same across all levels of another variable.

F 14. A cued recall test is an implicit memory test.

T 15. Memory is tested implicitly in the word fragment completion test.

T 16. Priming is said to have occurred when a person can complete more word fragments from previously studied items than from nonstudied items.

F 17. Amnesics typically have impaired implicit, but intact explicit memory.

T 18. In Warrington and Weiskrantz's study, the amnesics did worse than the controls on the explicit memory tests.

F 19. An interaction is obtained when each of two independent variables affects performance.

F 20. In a crossover interaction, a variable has one effect at one level of a second independent variable, and no effect at the other level of the second independent variable.

T 21. It is difficult to interpret interactions caused by ceiling or floor effects.

F 22. The appropriate use of a line graph for presenting data requires that the independent variable be measured at the nominal level.

ESSAY QUESTIONS

1. Using the example given in the Experimental Dilemma, discuss the advantages of having used a multifactor design in this situation.
2. Define implicit and explicit memory tasks. What is the nature of the interaction obtained with these two test types when the subjects are amnesics and normal controls?
3. Construct line graphs to illustrate
   a. one main effect
   b. two main effects
   c. an interaction
   d. one main effect and an interaction
   e. two main effects and an interaction
4. What are scale attenuation effects. Why are they a problem? How might they be avoided?

Chapter 11

Thinking and Problem Solving

IN OTHER WORDS

Often, in order to solve a problem, one has to look at it in a new way in order to find a different representation of the problem; this cognitive activity is called **thought**. Historically there have been two approaches to the study of thought. Thorndike's approach, based on operant conditioning and learning by trial-and-error, views problem solving as bottom-up processing. Thorndike observed cats learning how to escape from puzzle boxes. He observed that the cats gradually become more efficient in solving problems they had met before, and he concluded that they get more efficient by eliminating nonproductive behaviors, while behavior that led to success was "stamped in". This early work in problem solving led to the formulation of the **law of effect**. Gestalt psychology provides a top-down approach to thought. Kohler noted that chimpanzees often solved difficult problems suddenly, or with **insight**, after an initial period of random activity. The mathematician Poincare, outlined four stages in his thought processes. These include **preparation**, in which the solver learns the relevant facts and considerations, **incubation**, a period of putting the problem aside after failing to solve the problem, **illumination**, or insight, in which a solution to the problem suddenly appears, and **verification**, the testing of the solution.

Glick and Holyoak found that subjects were more successful in solving a difficult problem when they were able to solve it by **analogy**, that is by relating the current problem to a similar problem they had previously met. Holyoak theorized that successful analogical reasoning involves **mapping**, finding the correspondence between elements in the two problems. Successful mapping involves **structural consistency**, that is each individual correspondence that is identified is consistent

with mappings of other features. It is difficult to improve analogical reasoning in people. Holyoak found that the analogous problem was much more useful when subjects were given a hint that they should use the previous problem in solving the current one. Similarly, requiring the subject to describe the similarities between the two problems also improved performance. Spencer and Weisberg found that both increasing the time between the two problems, and changing the experimental context in which the problems were encountered, each reduced the number of solutions produced.

Analogical reasoning was used to explore issues of the **reliability of results**, whether an experimental outcome would be obtained again if the experiment were repeated. The key to insuring reliability of results is to run many subjects and make many observations. The greater the number of observations, the more sure we can be that the sample reflects the characteristics of the population. There are two basic ways of assessing reliability, statistically and experimentally.

Statistical reliability tells us how confident we can be that our experimental results were caused by the manipulation of the independent variable, and were not due to chance. Inferential statistics are used to evaluate a statistical **null hypothesis** that states that the independent variables produce no effect on behavior, and that any differences that are found are due to random error. We clearly hope to reject the null hypothesis (if it is wrong), and can do so more easily with large samples. Another way of saying this is that the **power** of a statistical test (to reject false null hypotheses) is increased with many observations.

Many psychologists consider experimental reliability more important than statistical reliability. **Experimental reliability** is demonstrated when the experiment is replicated and the same results are obtained. There are three types of experimental replication: direct, systematic and conceptual. **Direct replication** is repeating an experiment under essentially the same conditions. **Systematic replication** involves changes in variables believed to be irrelevant to the original results. **Conceptual replication** involved making radical changes from the original experiment. Systematic and conceptual replication are closely related to the concern of **generality of results**, and are useful in establishing the **boundary conditions** of the experimental findings, the conditions outside of which the phenomenon does not hold.

Functional fixedness refers to a difficulty in problem solving that results from having to use an object in an unconventional way. The major example in the text was Dunker's box problem in which a box had to be used as a platform to support a lighted candle instead of as a container. Research on functional fixedness suggests

that the more recently the object was used conventionally, the stronger the functional fixedness, and that verbal labeling the objects available reduces the phenomenon, presumably by encouraging the subject to consider each object individually.

Functional fixedness was used to explore issues of **experimental control**. Adamson (1952) performed a systematic replication of Dunker's original work in which two additional problems were tested, in addition to the box problem. Adamson measured the percent of solutions found, and how much time was required to find the solutions for groups of experimental and control subjects for each problem. He replicated Dunker's findings for the box problem, but found no difference in percent solutions for the other two problems due to a **ceiling effect**; almost all experimental and control subjects solved them. But because **latency** was recorded for successful solutions, it was possible to conclude that functional fixedness had indeed occurred, even for the easier problems.

The **verbal report**, or **subjective report**, is a commonly used dependent variable in studies of thinking and problem solving. The usefulness of the verbal report was considered in the context of group of studies concerned with **feeling of knowing**. When subjects were asked how likely they were to recognize the answers to questions of general knowledge that they were unable to recall, their confidence judgments were correlated with accuracy, but they tended to overestimate their ability to recognize the answers. The feeling of knowledge research suggests that verbal reports may not be useful in assessing cognitive activities, unless the reports are accompanied by other behavioral measures.

KEYWORD MATCHING

1.

____conceptual replication
____direct replication
____systematic replication
____what the above help to establish

A. changing non-critical factors in original experiment
B. experimental reliability
C. minimal changes from original experiment
D. new paradigm, or set of experimental conditions
E. statistical reliability
F. verification

2.

_____incubation
_____illumination
_____preparation
_____verification
_____what the above have to do with

A. appearance of problem solution
B. initial attempts at problem solving
C. law of effect
D. making sure the solution is correct
E. Poincare's stages in problem solving
F. setting problem aside and doing other things

3.

_____analogy
_____feeling of knowing
_____functional fixedness
_____insight
_____latency
_____thought

A. difficulty in using an object in an unconventional way
B. familiar problem that may aide in solving new problem
C. power
D. re-representation of a problem
E. sudden appearance of solution to a problem
F. time to problem solution
G. usually assessed by a verbal report

4.

_____boundary conditions
_____ceiling effect
_____experimental reliability
_____subjective report
_____null hypothesis
_____power
_____mapping
_____structural consistency
_____statistical reliability

A. ability of statistical test to reject false null hypotheses
B. another name for verbal report
C. closely related to generality of results
D. demonstration that experimental results are due to the independent variable and not due to chance
E. finding a correspondence between elements of two problems
F. internally consistent set of mappings between two problems
G. limits outside of which an experimental result will not be obtained
H. obtaining near perfect performance in one or more experimental conditions
I. statement that experimental results are due to chance

PROGRAMMED REVIEW

1. _____ has been defined as the "achievement of a new representation through the performance of mental operations."
2. Thorndike studied the behavior of cats in escaping from _____.
3. Thorndike observed that initial learning took place through _____ and _____.
4. Kohler emphasized the importance of _____ in problem solving in chimpanzees.
5. A result is _____ if a repetition of the original experiment produces the same outcome.
6. As the number of _____ increases, the likelihood that a result will be reliable also increases.
7. Variability is usually higher in (within/between) _____-subjects designs than in _____-subjects designs.
8. Comprehension by _____ involves understanding one thing in terms of another.
9. Glick and Holyoak (1980) found that problem solving through analogical reasoning was (improved/impaired) _____ if subjects were given an analogous problem story to read.
10. A result is statistically reliable if statistical analysis show that the results was not likely to have occurred by _____.
11. _____ statistics are use to determine whether an experimental result is due to the manipulation of the independent variable.
12. Researcher are more convinced by a result shown to the _____ reliable than one shown to be _____ reliable.
13. Three types of experimental replication are _____, _____, and _____.
14. in a(n) _____ replication, the experimenter might vary some factors believed the be irrelevant to a phenomenon but still keep the design quite similar to the original experiment.
15. _____ replications are analogous to converging operations.

16. A researcher who finds the limits within which a phenomenon will be observed is establishing the _____ conditions of the phenomenon.

17. Dunker found evidence of _____ _____ in his problem of affixing candles to a wall.

18. Adamson replicated Dunker's findings but measured _____, a more sensitive measure of performance than _____ _____.

19. Dunker's findings can be interpreted as evidence that problems are solved through _____, or a sudden restructuring of the problem.

20. In an experiment in which the _____ _____ _____ phenomenon is being studied, the subject might give confidence judgments as to how well they would do on a recognition test of specific information.

21. When subjects; confidence ratings are compared with actual teat performance in feeling-of-knowing studies, it is generally found that subjects are (more/less) _____ confident than is warranted by their knowledge.

22. Metcalfe's experiment on the "feeling-of-warmth" phenomenon revealed that subjects' ratings of their "feeling-of-warmth" was consistent with a _____ pattern to problem solving.

23. It is recommended that _____ reports be used as dependent variables only in conjunction with other behavioral measures.

24. _____ is a term used to refer to a problem solving process occurring during the time in which the problem us not consciously being considered.

EXPERIMENTAL PROJECT

Some research on brainstorming has suggested that certain sorts of problems are better solved by groups than by individuals. Give the following problem to three groups of five people and to three individuals. Record the amount of time necessary to produce the correct response, and compare average latencies of groups vs. individuals.

Problem: Misters Baker, Carpenter, Hunter, and Walker were (not respectively) a baker, carpenter, hunter, and walker by profession. The were in the habit of wearing shirts that were (again, not respectively) brown, cerise, heliotrope, and white in color. No man's profession was the same as his name, and the color of each man's shirt began with a different letter than his name or his profession. Mr. Hunter and the professional walker dined together regularly. The hunter violently

disliked the color brown, and would never wear a brown shirt. Mr. Carpenter was the baker. Find the profession of each man and the color of his shirt.

Solution: Mr. Baker is the walker and wore a heliotrope shirt; Mr. Carpenter is the baker and wore a white shirt; Mr. Hunter was the carpenter and wore a brown shirt; Mr. Walker was the hunter and wore a cerise shirt.

Now do a direct replication testing different subjects. Do you obtain the same results? What do your results tell you about brainstorming for the particular type of problem presented?

EXPERIMENTAL DILEMMA

A researcher interested in individual differences in problem solving submitted the following work for publication. Two groups of subjects - 30 English and 30 Mathematics majors - were tested on their ability to solve a spatial puzzle task. Subjects in the two groups were equated in age and IQ. Each individually tested subject was given a dismantled puzzle cube to solve, and as was told to take as long a necessary to reassemble the cube. Latency to solve the puzzle was recorded for each subject. The results showed a significant difference between groups with Math majors taking 9.8 minutes, and English majors taking 15.3 minutes to reassemble the cube. This result was replicated in a second experiment where subjects solved a task requiring map reading. (The procedure was similar to that of the first experiment.) The experimenter concluded that the results of the two experiments reflect a difference in spatial abilities between people who use spatial skills frequently (Math majors) and those who use such skills less often (English majors).

Would you accept this paper for publication is you were the journal editor? Why or why not?

MULTIPLE CHOICE QUESTIONS

1. Thorndike's experiments with puzzle boxes emphasized _____ in learning, whereas Kohler's studies on problem solving in chimpanzees emphasized _____ in learning.
   a. insight; operant conditioning
   b. trial and error; insight
   c. Gestalt; insight
   d. operant conditioning; trial and error

2. Which of the following is **not** true?
   a. Gestalt psychology has had a larger impact on current problem solving research that has behaviorism.
   b. Many of the problems posed to Kohler's chimpanzees had no simple or direct solution.
   c. The Gestalt approach to problem solving emphasizes elementalistic analysis of behavior.
   d. The initial successful behaviors of Thorndike's cats seemed to come about merely by trial and error.
3. Which of the following is **least** likely to be used as a dependent variable in a problem solving experiment?
   a. proportion of subjects who solve the problem
   b. level of difficulty
   c. latency
   d. quality of solution
4. Which of the following would **not** be an appropriate independent variable in the study of problem solving?
   a. the manner in which the problem is presented
   b. the amount of irrelevant information presented
   c. the presence or absence of stress
   d. none of the above
5. Which of the following dependent variables is likely to be a more sensitive measure in most problem solving experiments?
   a. time taken to solve the problem
   b. percentage of subjects able to solve the problem
   c. goodness of the solution
   d. all of the above are equally sensitive
6. A researcher who conducts an experiment once and then repeats that same experiment again to see it the same results will be observed is interested in the issue of
   a. ecological validity
   b. statistical reliability
   c. experimental reliability
   d. experimental control

7. The greater the number of observations upon which a sample statistic is based
   a. the greater the reliability of the statistic
   b. the greater the variability of the statistic
   c. the greater the error component of the statistic
   d. none of the above.

8. The use of between-subjects designs in problem solving experiments
   a. tends to increase the variability of the observations.
   b. often makes it difficult to detect differences between conditions.
   c. frequently leads to a reduction in the number of observations per experimental condition.
   d. all of the above.

9. Glick and Holyoak (1980) conducted research in which a subject's attempt to solve a problem was sometimes preceded by the presentation of a similar problem story. These experimenters were interested in
   a. error variance
   b. analogical reasoning
   c. feeling of knowing
   d. functional fixedness

10. Research on problem solving has shown that
    a. problem solving performance is improved when subjects read an analogous problem story prior to solving a problem.
    b. relationships between analogous problems sometimes must be made explicit in order to be useful in problem solving.
    c. analogies are not very helpful as hints in problem solving activities.
    d. both *a* and *b*

11. A result is said to be statistically reliable if
    a. the results is replicated under conditions that are very different from those of the original experiment.
    b. the number of observations in each experimental condition is high.
    c. there is only a slight probability that the result occurred by chance.
    d. all of the above

12. It is important to show that a result is experimentally reliable because the results of the original experiment
    a. may have occurred by chance.
    b. may be due to confounding.
    c. may be due to experimental error.
    d. all of the above

13. A _____ replication is more similar to the original experiment than is a _____ replication.
    a. conceptual; direct
    b. direct; conceptual
    c. conceptual; systematic
    d. systematic; direct

14. The reliability of an experimental result is enhanced when the experiment
    a. can be conceptually replicated.
    b. is repeated and the same results are obtained.
    c. is based on a large number of observations.
    d. all of the above.

15. The study by Spencer and Weisberg, in which they repeated the Glick and Holyoak experiment on problem solving, showed that
    a. Glick and Holyoak's are not replicable,
    b. Glick and Holyoak used a poor experimental design.
    c. analogical reasoning is not readily generalized to new problems and situations.
    d. solving new problems is seldom aided by prior problem solving experience.

16. In general, _____ decreases as _____ increases.
    a. statistical reliability; experimental control
    b. error variance; experimental control
    c. experimental control; power
    d. experimental control; statistical reliability

17. A result that is not experimentally reliable
    a. will probably not generalize to new settings.
    b. may be conceptually replicated.
    c. cannot be statistically reliable.
    d. none of the above

18. The procedure of converging operations is quite similar to _____.
    a. direct replication
    b. systematic replication
    c. conceptual replication
    d. statistical replication

19. People who are trying to solve a problem have a tendency not to use objects that already have functions when trying to implement a new function. The phenomenon is called
    a. functional fixedness
    b. vertical thinking
    c. feeling of knowing
    d. analogical reasoning

20. Verbal reports
    a. should be used only as converging evidence with other behavioral measures.
    b. are generally permissible as data under the tenets of behaviorism.
    c. have been completely phased out of modern psychological research
    d. are common dependent measures in all types of psychological studies.

21. Feeling of knowing is a term used to refer to
    a. a person's mental experience when using an analogy to solve a problem.
    b. the tendency for subjects to underestimate their knowledge.
    c. a person's ability to evaluate his or her own knowledge.
    d. the importance of experimental reliability in psychological research.

22. The feeling-of-knowing research
    a. stresses the shortcomings of using phenomenological reports of cognitive processes in psychological research.
    b. shows that subjects are extremely accurate in monitoring their higher-order cognitive processes.
    c. shows that subjects tend to underestimate their own accuracy in memory tests.
    d. none of the above

23. Research by Janet Metcalfe on the "feeling of warmth" (i.e., the feeling that you are getting close to solving a problem) indicates that
    a. when people report that they are "warm" they can generally give a correct solution.
    b. people who are warm are more likely to give an incorrect than a correct solution.
    c. there is no relation between "feeling warm" and actual problem solutions.
    d. the "feeling of warmth" is related to deductive but not inductive reasoning.

TRUE-FALSE QUESTIONS

____ 1. Thorndike's cats were trained to escape from the puzzle boxes to avoid shock.

____ 2. Thorndike's cats learned to escape from the puzzle boxes by trial and error,

____ 3. Kohler's chimpanzees were given problems that had simple and direct solutions.

____ 4. Kohler found that chimpanzees were unable to solve problems requiring insightful solutions.

____ 5. Latency is an inappropriate dependent variable for problem solving.

____ 6. It is important to use sensitive dependent variables in problem solving experiments so that ceiling effects may be avoided.

____ 7. One factor that might be varied in a problem solving experiment is the amount of irrelevant information presented to the subject,

____ 8. Confidence in an experimental result increases as the number of observations per experimental condition increases.

____ 9. A result may be either experimentally reliable or statistically reliable but not both at the same time.

____ 10. The chances of a results being statistically reliable decrease as the variability in the data increases.

____ 11. Since between-subjects designs have lower variability in the data they produce, they are preferable to within-subjects designs.

____ 12. Between-subjects designs generally have more observations per condition than do within-subjects designs.

____ 13. Glick and Holyoak (1980) found that analogical reasoning can facilitate problem solving performance.

____ 14. Sometimes the relationship between two analogous problems must be made explicit before it can be used effectively as a problem solving tool.

____ 15. Statistical reliability is established through the use of inferential statistics.

_____ 16. If a result is statistically reliable we know that the probability of its occurring by chance is very small.

_____ 17. A result may be statistically reliable without being experimentally reliable.

_____ 18. A direct replication involves the use of independent variables not manipulated in the original experiment.

_____ 19. Conceptual replications are analogous to converging operations.

_____ 20. If a result generalized to a new setting, then it must be reliable.

_____ 21. Duncker found that subjects overlook a novel use for a common object in a problem solving task if that object had already been assigned an intended use.

_____ 22. Because Adamson did not have a sensitive dependent variable in his experiments, he failed to replicate Dunker's research on functional fixedness.

_____ 23. If an extraneous variable is unintentionally varied along with the independent variable of interest, the experimenter must conclude that the results are due to the effects of the extraneous variable.

_____ 24. The use of phenomenological reports is in close accord with the rules of behaviorism.

_____ 25. Feeling-of-knowing experiments suggest that phenomenological reports bear no relation to cognitive processes.

_____ 26. Verbal reports are best used as converging operations with other behavioral measures.

_____ 27. When subjects report that they are very close to the solution of a problem, they are more likely to give an incorrect than a correct response.

ESSAY QUESTIONS

1. What is reliability. What does it mean if a result is statistically reliable?
2. Discuss the potential problems of using between-subjects designs in problem solving research. Why are between-subjects designs used so often it they present such problems?
3. Discuss the experiments on analogical reasoning, and relate them to the concept of experimental replication.

Chapter 12

Individual Differences and Development

IN OTHER WORDS

In the study of individual differences, as in the study of any topic, there are two basic methods of scientific inquiry that might be used. The **empirical approach**, or deductive approach, attempts to predict behavior of interest on the basis of whatever events correlate well with that behavior. For example, **intelligence** tests are devised for the purpose of predicting subsequent scholastic performance, and constitute **operational definitions** for intelligence. The **analytic approach**, or inductive approach, is based on theory, and uses the theory to guide research and make behavioral predictions. To date, the empirical approach has been more successful than that analytic approach in identifying good predictors of intelligence.

Individual differences are measured by tests of one sort or another. Useful measures of individual differences are **valid**; that is they measure what they are supposed to measure. A test that has **face validity** appears to be appropriate for measuring whatever the test measures; it asks the right kind of questions. **Predictive (criterion) validity** refers to the extent to which the test scores actually predict the behavioral criterion of interest. Predictive validity is usually measured by finding out how well the test scores correlate with measures of the criterion behavior.

In addition to being valid, good tests are also **reliable;** they measure the same attribute each time they are administered. A score on a test can be viewed as being composed of two components, a "true value" component, and a random error component that results from the imprecision of the test. A test is more reliable when the error component is small. Test reliability may be determined in a variety of ways. **Test-retest reliability** tells how consistently the test measures over time, and is

measured by correlating the scores from separate administrations of the test to the same subjects. When it is desirable to have alternative forms of the same test, the **parallel forms** reliability can be found by correlating the scores made by the same subjects on the two versions of the test. The internal consistency of a test, whether all parts of the test measure the same thing, can be measured by determining the **split-half reliability** of the test. Split-half reliability is often determined by correlating the scores made on the odd-numbered items with the scores made on the even-numbered items.

In developmental studies, including studies of intelligence, age is often a subject variable of interest. There are several ways in which the effects of age may be examined. In **cross-sectional designs**, subjects of different age groups are compared on their performance. A major problem with this approach is that people in one age group grew up with different people (**cohorts**) than people in another age group. This influence (**cohort effects**) is confounded with age, making it impossible to determined whether age or one of the cohort effects is responsible for any behavioral difference. This confounding is eliminated in **longitudinal designs**, in which the same group of subjects is tested repeatedly over a period of several years. Results of longitudinal studies may be contaminated, however, by the influence of any historical events occurring during the course of the study. Clearer interpretation of results is possible when a **cross-sequential design** is used, which includes both cross-sectional and longitudinal designs. In the cross-sequential design, people born at different times are tested repeatedly at different ages. This design also permits a comparison between people born at different times when they are of the same chronological age (a **time-lag design**), allowing the effects of historical events to be identified and separated from age effects.

Definitions of personal traits are seldom agreed on. Intelligence, for example is operationally defined in a variety of ways in terms of many difference tests. The IQ score is defined as 100 X **mental age/chronological age**. The mental age of a person is measured by the difficulty of the questions he or she can answer, while the chronological age is the length of time since birth. The **Turing test** is a definition of intelligence that allows one to determine whether an **artificially intelligent** computer is, in fact, intelligent. The computer is said to pass the test if a human interrogator is unable to distinguish between a human's responses to questions and the machine's responses. Turing thought that it is theoretically possible for a computer itself to possess real intelligence (**strong AI**) in addition to being able to model various aspects of human cognition (**weak AI**). The philosopher Searle, among others, does not accept the strong AI position and objects to the Turing test as defining anything like human intelligence. He described a thought experiment, called the **Chinese**

room argument, in which a English speaking human could pass a Turing test in Chinese without actually knowing the Chinese language. Gardener offers yet another definition of intelligence in his theory of **multiple intelligences**. For Gardener, an intelligence is a cluster of abilities that is associated with separate neural structures, has its own developmental history, and is independent from other intelligences. Musical intelligence and linguistic intelligence, for example are associated with difference regions of the brain - damage to the left hemisphere may produce **aphasia**, a language disorder, while damage to the right hemisphere may produce **tonal agnosia**, an inability to sing and a reduction in normal inflections. There are great individual differences in both musical and linguistic ability and they are uncorrelated with each other.

Attributes along which people differ from one another, such as age, gender, intelligence, etc., are referred to as **subject variables**. Comparing one level of a subject variable with another involves **quasi-experimental designs**, because the researcher is unable to randomly assign subjects to the levels of the subject variable. This means that we can never be sure that the subject variable was responsible for any observed differences in behavior, and not some unknown factor that was confounded with it.

It is often the case in quasi-experimental research, that subjects are matched on other variables believed to be important to the behavior of interest. This matching procedure makes it likely that **regression artifacts** will affect the results of the study, especially when it is necessary to select extreme matching scores from one group to match the scores of another. The extreme scores on the matching test are likely to be inflated or reduced because of measurement error; people making these scores will likely show **regression to their group mean** when they are further tested in the study.

KEYWORD MATCHING

1.

____AI
____Chinese Room
____strong AI
____Turing test
____weak AI

A. argument against strong AI
B. intelligence in a computer
C. modeling cognitive processes on computer
D. operational definition of machine intelligence
E. possibility of human-like computer intelligence

2.

_____analytic approach
_____empirical approach
_____operational definition
_____subject variable

A. correlational research to create predictors of individual differences
B. dimension of individual differences
C. specifying a dimension of individual differences in terms of how measurements are made
D. theory guided research to gain understanding and to create predictors of individual differences

3.

_____aphasia
_____chronological age
_____intelligence
_____mental age
_____multiple intelligences
_____tonal agnosia

A. denominator of the IQ
B. inability to sing usually associated with right hemispheric damage
C. language disorder usually associated with left hemispheric damage
D. measured by the difficulty of questions that one can answer
E. something measured by many operational definitions
F. theory proposed by Gardner

4.

_____cross-sectional design
_____cross-sequential design
_____longitudinal design
_____quasi-experimental design
_____time-lag design

A. subjects born in different years are compared to each other when they reach a particular age
B. subjects are assigned to groups on the basis of measurements of a subject variable
C. subjects born in different years are tested once, at the same time
D. subjects born in different years are each tested when they reach particular ages
E. subjects born in the same year are tested repeatedly when they reach particular ages

5.

_____face validity
_____parallel form reliability
_____predictive validity
_____reliability
_____split-half reliability
_____test-retest reliability
_____validity

A. appearance that a test is asking the right sort of questions
B. consistency of test scores
C. correlation of test scores with behavioral criterion
D. determination of whether a test measures what it is supposed to measure
E. used to determine if different parts of the same test measure the same thing
F. used to determine if two versions of a test measure the same thing
G. used to determine how consistent test scores are over time

6.

_____cohort
_____cohort effects
_____regression artifact
_____regression to the mean

A. a person that someone grows up with
B. score on a second test is likely to be closer to the mean of the test-taker's group than an extreme score on a first test
C. source of confounding in cross-sectional designs
D. source of contamination in quasi-experimental designs that include matching of subjects

PROGRAMMED REVIEW

1. _____ approaches to scientific inquiry make predictions on the basis of theoretical understanding.
2. _____ approaches make predictions based on observations of events accompanying the event of interest.
3. The original reason for constructing intelligence tests was to predict performance in _____.
4. _____ has been operationally defined as the ability to succeed in school.

5. A test has _____ validity if it seems to measure the construct it was intended to measure. A test has _____ validity if it predicts a criterion behavior well.
6. The _____ approach offers understanding in addition to predictive power.
7. IQ is defined as 100 X _____ age divided by _____ age.
8. An important factor to be controlled in the study of intelligence is specific _____ that could affect test performance.
9. _____ refers to the consistency of the measure of some property.
10. When assessing the reliability of a test we assume that changes in test scores over a short period of time are due to _____ _____.
11. _____-_____ reliability is assessed by correlating scores from repeated administrations of the same test given to the same people.
12. As the correlation between test scores obtained from separate administrations increases, _____ is said to increase.
13. In order to avoid practice effects when assessing test reliability, _____ _____ of the test may be administered on two separate occasions.
14. The _____-_____ technique of assessing reliability involves the arbitrary division of test items into two groups, and correlating the scores from each group of items.
15. _____ variables cannot be experimentally manipulated.
16. Research with subject variables is largely _____ in nature, rather than experimental.
17. In a(n) _____-_____ design, the researcher takes a cross-section of the population and tests them in the procedure of interest.
18. Age is likely to be confounded with other factors of interest in _____-_____ designs.
19. _____ effects refer to the confoundings produced by the fact that different sorts of people grow up with people of varying ages.
20. _____-_____ studies have shown that IQ decreases in late adulthood, but _____ studies show that IQ continues to increase.

21. In a(n) _____ study the same group of subjects is tested repeatedly over time.

22. The results of _____ studies may reflect effects of historical events occurring during the course of inquiry.

23. The problems inherent in cross-sectional and longitudinal designs are eliminated in _____-_____ designs.

24. The effects of time of testing are assessed while holding age constant in a _____-_____ design.

25. A _____ test was proposed to allow researchers to determine whether a machine has intelligence.

26. The experiment embodied in a Turing test represents a(n) _____ definition of intelligence.

27. The view that machines can have real intelligence is known as _____ AI.

28. Operational definitions are in principle reliable but they may not be _____.

29. The seven intelligences identified in Gardner's theory of multiple intelligences are 1)_____, 2)_____, 3)_____, 4)_____, 5)_____, 6)_____, and 7)_____.

30. Robert Sternberg's operational definition of intelligence suggests that intelligent behavior reflects and individual's ability to solve problems established in a _____ _____.

31. _____ _____ are experimental effects produced by statistical regression to the mean rather than by experimental manipulations.

32. Regression artifacts are due to _____ error.

EXPERIMENTAL PROJECT

In order to gain some insight in the to logistics of constructing a test instrument, perform the following exercise in constructing an attitude scale. The scale will measure attitudes toward pornography and will consist of a series of statements to which subjects will respond "strongly agree", "agree", "no opinion", "disagree", or "strongly disagree". As you write each item classify it as either being in favor of or opposed to pornography. For instance, a statement such as "Erotic films are a natural form of artistic expression" would be classified as a pro pornography statement, whereas "Nude magazines serve no purpose other than to exploit the

models appearing in them" would be considered a statement against pornography. (Normally these decisions would be made by a panel of judges, but for the present purpose you own opinion will suffice.) Write an equal number of pro and con statements. Your test should contain at least 30 items and they should appear in a random order. Administer the test to several people (at least 10) and have them indicate their agreement or disagreement with each item. In scoring items classified as being pro pornography, a response of "strongly disagree" should receive a "1", "disagree" should receive a "2", and so forth. For anti-pornography statements, reverse the scoring so that a "strongly disagree" response should receive a "5", etc. Scores for each subject may be obtained by simply totaling the points for each answer. In order to establish the test-retest reliability of your scaling instrument, you should readminister the test about two weeks later to the same subjects, and correlate the scores with a Pearson product moment coefficient of correlation.

What reliability coefficient did you obtain? How could you measure the split-half reliability of your test? How might you improve your attitude scale?

EXPERIMENTAL DILEMMA

A researcher submitted the following work to a journal for publication. Twenty second graders were selected to participate in a remedial reading program based on scores obtained on a general reading skills test given to all children in the school system. The students were chosen because they did not perform as well as their classmates, and it was hoped that the program would improve their reading ability. The program involved individual sessions with a special instructor three hours a week for six weeks. At the end of this period, the test was readministered to the students in the program. Scores were compared with those of children of similar ability from another grammar school in the area who took the test again at the same point in the school year as the children in the remedial program. The results showed no difference between scores for students who had participated in the remedial program and those who had not. Although the researcher wanted to concluded that the program had been ineffective, a reviewer argued that the results could have been due to regression artifacts.

Do you agree with the reviewer? Why or why not?

MULTIPLE CHOICE QUESTIONS

1. Which of the following subject variables might be of interest to a psychologist studying individual differences?
   a. age
   b. sex
   c. educational level
   d. all of the above
2. The analytical approach to the study of individual differences attempts to
   a. predict behavior based on observations of events that tend to accompany the behavior of interest.
   b. predict behavior on the basis of a theoretical understanding of the causes of the behavior.
   c. classify behavior with no attempts at prediction.
   d. study underlying causes of behavior with no attempts at prediction.
3. The empirical approach to the study of individual differences attempts to
   a. predict behavior based on observations of events that tend to accompany the behavior of interest.
   b. predict behavior on the basis of a theoretical understanding of the causes of the behavior.
   c. classify behavior with no attempts at prediction.
   d. study underlying causes of behavior with no attempts at prediction.
4. Which of the following is a true statement?
   a. Thus far the empirical approach to intelligence has yielded better predictors of future scholastic performance than has the analytical approach.
   b. Researchers prefer the empirical approach to intelligence because it offers understanding in addition to predictive power.
   c. The analytical approach may be improved as the result of advances in the empirical approach, but not vice-versa.
   d. Analytical researchers have had almost no success in breaking intelligence down into its mental components.
5. A 10 year old child with a mental age of 12 has an IQ of
   a. 100
   b. 83
   c. 120
   d. 110

6. In IQ score of 100 reflects
   a. above average intelligence.
   b. below average intelligence.
   c. perfect performance on the IQ test.
   d. none of the above

7. The original reason for using intelligence tests was to
   a. classify people with respect to their mental potential.
   b. predict academic performance.
   c. provide a toll to study intelligence.
   d. study the effects of educational level on intelligence,

8. In studies of intelligence, the most important control variable is
   a. motivation.
   b. scholastic ability.
   c. socioeconomic status.
   d. specific learning.

9. An experimenter interested in intelligence measured a subject's IQ on two separate occasions occurring two weeks apart. The first session yielded an IQ of 126 and the second test produced a score of 120. The difference of 6 points is most likely due to
   a. subject variability.
   b. measurement error.
   c. test-retest reliability.
   d. specific learning.

10. Unpredictable variability in data may occur due to
    a. subject variability.
    b. measurement error.
    c. experimenter error.
    d. all of the above.

11. Which of the following is true?
    a. We may assess the reliability of a test if we assume that the property being measured remains stable over short periods of time.
    b. Psychologists are in general agreement over which mental capacities constitute intelligence.
    c. The traditional IQ test grew out of an analytical approach to intelligence.
    d. The split-half technique measures stability, but the test-retest procedure does not.

12. The reliability of a test refers to
    a. whether the test measures what it is intended to measure.
    b. how well the test can predict future performance.
    c. how stable scores are across testings of the same subjects.
    d. how stable scores are across different groups.

13. A test is reliable if the
    a. test-retest correlation is high.
    b. correlation between parallel forms of the test is high.
    c. correlation between two halves of the test is high.
    d. all of the above

14. Longitudinal studies of intelligence generally show that IQ scores
    a. decline steadily once an individual reaches early adulthood.
    b. obtained during childhood are generally good predictors of adult IQ.
    c. for childhood and adulthood are uncorrelated.
    d. none of the above.

15. The Kangas and Bradway (1971) study showed that
    a. compared with other groups, high IQ females seem to gain much less in IQ with age.
    b. IQ increases with age for women, but remains stable for men.
    c. high IQ individuals gain in IQ level throughout life, but low IQ individuals remain stable.
    d. changes in high IQ scores were uninterpretable due to ceiling effects.

16. Given that age is a subject variable,
    a. it may be directly manipulated in an experimental design.
    b. it is easy to attribute causation to the age factor, as opposed to any other factor in an experimental design.
    c. it is examined largely in correlational studies rather than in experimental studies.
    d. it may only be treated as a control variable in developmental research.

17. When characteristics of people, or individual differences, are studied, they are referred to as _____ variables.
    a. independent
    b. subject
    c. control
    d. dependent

18. A researcher interested in the long-term effects of nuclear waste monitors the health of 15 families living near a waste disposal site. The researcher records any instance of physical or mental illness reported by the families over a period of 10 years. This sort of study is called a _____ design.
    a. cross-sectional
    b. cross-sequential
    c. longitudinal
    d. time-lag

19. In a longitudinal design
    a. the confoundings inherent in cross-sectional designs are avoided.
    b. results may be produced by historical events occurring during the course of the study.
    c. the same group of subjects are repeatedly tested as they grow older.
    d. all of the above.

20. Cross-sequential research designs
    a. allow for causal inferences concerning the effect of subject variables.
    b. confound age with other subject variables of interest.
    c. are much more difficult to run that longitudinal studies.
    d. all of the above

21. Which of the following is an acceptable operational definition for fear of snakes?
    a. change in heart rate when a snake is presented
    b. distance voluntarily maintained between the snake and the subject
    c. amount of time spent handling the snake
    d. any of the above

22. The view that machines can have intelligence is consistent with
    a. weak AI.
    b. strong AI.
    c. multiple intelligences.
    d. use of the Turing test.
    e. both *b* and *d*

23. Which of the following intelligences are not assessed on "standard" IQ tests?
    a. linguistic
    b. musical
    c. logical-mathematical
    d. spatial

24. A Turing test is an example of
    a. an operational definition
    b. a psychometric measure
    c. a theory
    d. an unreliable but valid measure
    e. both *a* and *d*

25. Regression artifacts
    a. may be avoided with the use of counterbalancing.
    b. are not a problem when subject variables are being studied
    c. are a major problem when subject populations differ.
    d. occur when the effects of an experimental manipulation subside over time.

TRUE-FALSE QUESTIONS

_____ 1. One general goal of science is to derive accurate predictions of future events.

_____ 2. Empirical approaches to science offer theoretical understanding in addition to predictive power.

_____ 3. Empirical researchers are suspect of any predictor variable that has low face validity.

_____ 4. Analytical and empirical approaches to intelligence may be viewed as complementary rather than antagonistic.

_____ 5. Intelligence has been operationally defined in terms of IQ scores.

_____ 6. Variability in the form of measurement error across tests may be reduced if measures are taken under identical conditions on those separate occasions.

_____ 7. Measurement error is easy to assess if one assumes that the measured property is unstable across short periods of time.

_____ 8. If the correlation between test scores obtained on two separate occasions is low, we say that the test has good reliability.

_____ 9. The split-half procedure for assessing reliability is superior to the parallel forms technique because usually more subjects are tested with the split-half procedure.

_____ 10. Longitudinal studies of intelligence have shown that IQ declines with age.

____ 11. Longitudinal designs tend to confound age with other subject variables.

____ 12. Research with subject variables is largely correlational in nature.

____ 13. Cross-sectional designs are likely to produce results that permit causal inference.

____ 14. Longitudinal and cross-sectional studies of intelligence often produce conflicting patterns of results.

____ 15. Time-lag designs determine the effects of time of testing while holding age constant.

____ 16. Cross-sequential designs include both longitudinal and cross-sectional components.

____ 17. An operational definition allows a term to be defined by the procedures used to measure it.

____ 18. Anxiety level might be operationally defined in terms of the number of chocolates eaten in an hour.

____ 19. A Turing test is a reliable operational definition of intelligence.

____ 20. The Turing test provides a well specified and generally accepted as valid approach to defining intelligence.

____ 21. According the philosopher Searle, the "Chinese room" demonstrates that a Turing test is not a valid way to show that machines have intelligence.

____ 22. People suffering from tonal agnosia are unable to sing.

____ 23. Regression to the mean is a statistical, rather than an experimental, artifact.

____ 24. Regression artifacts would never be a problem if measurement error could be completely eliminated.

____ 25. Regression artifacts pose very few problems as long as subjects are drawn from different underlying populations.

ESSAY QUESTIONS

1. Contrast three methods for assessing test reliability.
2. What is a cross-sequential design. How is it an improvement over other research designs employing subject variables?
3. Why is it useful to examine interaction effects in studies employing subject variables?
4. Briefly summarize Gardner's and Sternberg's theories of intelligence.
5. What are regression artifacts? Make up a scenario in which regression artifacts might lead to the faulty interpretation of data, other than those used in the text.

Chapter 13

Social Influence

IN OTHER WORDS

Social psychology is the study of society's influence on the behavior of the individual. One of the topics studied by early social psychologists is **conformity** to **social norms**, the generalized rules of conduct that tell us how to behave. Sherif showed that the influence of these social norms is powerful in his study of the autokinetic phenomenon. A dim light in a dark room is often observed to move, and subjects reports of this movement were strongly influenced by the reports of other observers. Similarily Asch showed that peoples estimates of line lengths were greatly influenced by the false estimates given by other (confederate) subjects.

Milgram's research on **obedience** to authority was used to examine the issues of experimental control. Milgram found that a surprising large number of subjects obeyed the experimenter's orders to deliver (apparently) painful electric shocks to a (confederate) learner whenever the learner made mistakes in learning a list of words. In later experiments Milgram found that subjects were less likely to obey if other (confederate) subjects refused to obey, and that obedience decreased as the learner was positioned closer to the subject.

Clean experimentation in social psychology is difficult because of the complexity of the experimental situations. **Experimental control** has to do with gaining control of the many extraneous variables that might distort the experimental results. **Experimental error** occurs whenever changes in the dependent variable do not come about through changes in the independent variable, but rather are due to some other factor.

The chapter mentions several sources of experimental error. **Confounding** is said to occur when some uncontrolled factor happens to change at the same time as changes in the levels of the independent variable. It is important to ensure that these extraneous variables influence all conditions of the experiment equally. One way of doing this is to hold them constant; variables so controlled are called **control variables**. When it is impossible to hold a variable constant, then **randomization** might be used to increase the chances that the variable influences all conditions of the experiment in the same way. Randomization is used commonly to assign subjects to levels of the independent variable; this does not eliminate subject differences, but it increases the likelihood that the experimental groups are equivalent on the average.

Other sources of experimental error are the influences that expectations play on the data that is collected. **Experimenter bias** refers to the any influence that the experimenter's hopes, beliefs, or expectations play on the data collected. Usually experimenter bias takes the form of subtle and unintentional differences in the way that subjects in different experimental groups are treated. Experimenter bias may be controlled if the data collector is unaware of the hypothesis being tested in the experiment, and of which treatment an individual subject has received; such a data collector is said to be **blind**.

Demand characteristics refer to features of the experiment that lead subjects to have expectations about what ought to happen, and how they ought to behave. Demand characteristics often represent a greater source of experimental error than experimenter bias. In medical settings, demand characteristics are referred to as **placebo effects**. Steps that can be taken to minimize demand characteristics include conducting the study as a **single-blind experiment**, in which the subject is unaware of which treatment he or she is receiving, or as a **double-blind experiment** in which both the data collector and the subject are blind as to the nature of the treatment. Still another approach is one that Orne used in a study of hypnotism. Control subjects were told to act as though they were hypnotized (**simulating control subjects**) in a study on hypotism. Any differences in behavior between these subjects and those subjects actually hypnotized could be attributed to the effect of hypnotism itself, and not to the demand characteristics in the experiment. Finally, demand characteristics can be avoided in **field research**, in which the experiment is conducted in a natural enviroment.

Field research was discussed in the context of research on **bystander intervention**, the extent to which people provide help in a crisis situation. Early work on bystander intervention suggested that the larger the number of bystanders, the

less likely it was that help would be offered. The result has been explained in terms of a "**diffusion of responsibility**"; when there are many bystanders, each bystander feels less responsible. When this work was replicated in the field, there was no effect of the number of bystanders. Presumably the difference between the laboratory and field studies is due to an **interaction** between the number of bystanders and some unknown factor.

Work on bystander intervention has been related to work on conformity and obedience to authority under the rubric of social impact. Latiné suggests that the number of people in a group has different effects on the target of group influence to conform or obey, and on the contribution that an individual member makes to the group impact. Pressure to conform or obey increases with the size of the group, but the increase is less with each additional member; **I(mpact) = N(umber)^t**, where t is a power less than 1.0. When the consideration is on how much each member contributions to group impact, as the group gets larger, the contribution of each member becomes less; diffussion **($I=N^{-t}$)**.

KEYWORD MATCHING

1.

____bystander intervention
____conformity
____obedience
____social facilitation
____social loafing
____social norms
____social psychology

A. effect of other's behavior on perceptual judgement; studied by Asch and Sherif
B. generalized rules of conduct that tell us how to behave
C. helping behavior in emergencies; studied by Latiné
D. individual effort is greater in presence of others than it is in private
E. individual effort is less in groups than in private
F. order-following behavior; studied by Milgram
G. study of the impact of other people on behavior of individual.

2.

_____blind
_____control variables
_____double-blind experiment
_____experimental control
_____field research
_____randomization
_____simulating control subjects
_____single-blind experiment

A. means of assigning subjects to conditions to minimize confounding
B. control for demand characteristics, often used in hypnosis research
C. factors that are either held constant or deliberately randomized in an experiment
D. gaining control over extraneous variables in experiment
E. research performed in public setting to increase generality of results
F. subject and tester are unaware of test condition
G. subject is unaware of test condition
H. tester is unaware of experimental hypothesis and test condition of subject

3.

_____confounding
_____demand characteristics
_____experimental error
_____experimenter bias
_____placebo effect

A. change in behavior occurs for some other reason than changes in the independent variable
B. influence on behavior from expectations of experimenter
C. influence on behavior from knowing you are in an experiment
D. medical improvement from inactive drug
E. simultaneous change in an extraneous factor in experiment with the independent variable

4.

_____diffusion ($I=N^{-t}$)
_____diffusion of responsibility
_____impact ($I=N^{t}$)

A. effect of increasing the number of others on target's behavior
B. effect of increasing the size of the group on an individual group member's effectiveness
C. the larger the group, the less personally responsible a member feels

PROGRAMMED REVIEW

1. The topics studied in social psychology deal with the impact of _____ on the behavior of the individual.
2. McDougall espoused thre view that behavior is largely determined by _____.
3. The _____ phenomenon is a perceptual illusion in which a stationary light appears to move by itself.
4. Sherif showed that a person's perceptual judgements could be influenced by the _____ of others.
5. Asch studied a visual discrimination task in which subjects were to decide which of three lines was closest in length to a(n) _____.
6. Asch showed that subject's visual discrimination judgements matched the erroneous judgements of the _____.
7. Social psychologists are beginning to study _____ behavior rather than covert preference.
8. Psychologists perform experiments to discover the _____ of behavior.
9. The _____ variable is directly manipulated by the experimenter, whereas the _____ variable is the behavior that is measured.
10. Experimental _____ occurs when a change in the dependent variable is produced by some other factor than the independent variable.
11. _____ occurs when a second variable is unintentionally varied along with the independent variable.
12. Factors other than the independent variable that are held constant across experimental conditions are called _____ variables.
13. _____ makes it unlikely that a factor will affect an experimental outcome even though it is not experimentally controlled by the experimenter.
14. In Milgram's obedience studies the (teacher/learner) _____ was the subject, and the (teacher/learner) _____ was a confederate.
15. Milgram's teacher-subjects were instructed to deliver shock to the _____ whenever a mistake was made.

16. One form of experimenter bias may occur when an experimenter covertly communicates his or her _____ to the subject.
17. One form of _____ bias is the deliberate faking of data.
18. An experimenter who is unaware of the experimental condition being tested in said to be _____.
19. _____ _____ are cues that govern the subject's behavior in an experimental setting.
20. Results produced by either experimenter or subject bias will not _____ to other settings.
21. A(n) _____ _____ occurs if a medical patients's condition improves just beause she believes that treatment has been administered, when in fact no real treatment has been given.
22. Subjects under _____ may be led to perform destructive acts.
23. It has been shown that antisocial behaviors exhibited by hypnotized subjects are probably due to _____ _____.
24. _____ research is conducted in natural settings instead of the laboratory.
25. The problem of _____ characteristic and the issue of the _____ of results normally faced in laboratory work are overcome in field research.
26. The topic of _____ _____ refers to the willingness of strangers to lend aid to a victim durng an emergency.
27. Although _____research suggests that the number of bystanders present at the scene of a crisis is an important factor in intervention behavior, _____ research suggests otherwise.

EXPERIMENTAL PROJECT

Although the text stressed the fact that people are often reluctant to lend aid to strangers is social emergencies, instances of altruism, or helping behavior, are quite common. This project will be an opportunity for you to explore altruistic behavior in the form of monetary aid. Your task is to approach strangers in a social setting as ask them to give you a quarter. You should pick a seting such as a department store in which you will be able to test a cross-section of the population.

There will be three experimental conditions and all will be determined by the nature of the request.

In the first condition you will ask for quarters without giving a reason for the request. In the second condition the request will be accompanied by the explanation that you need to make a phone call. For the explain that you need the quarter because your wallet has just been stolen.

Previous research suggests that the incidence of altrustic behavior will increase with the seriousness of the need, although some people will give you a quarter even though you provide no reason for the request. You should gather at least ten observations in each of the three conditions. Tabulate the percentage of people complying with your request in each of the three conditions. Do your results correspond to previous findings? If not, what aspect(s) of the study produced the different results.

EXPERIMENTAL DILEMMA

An experimenter conducted a study to test the hypothesis that people who are frustrated will be less likely to help a stranger than will those who are less frustrated. All subjects were tested individually. Subjects were asked to solve a 15 piece impossible jigsaw puzzle in a room in which there was either 20 dB or 40 dB white noise. Subjects were told that the puzzle would form a perfect square when finished, and were unaware that there was no solution to the puzzle. It was believed that increases in noise level would produce increases in frustration at not being able to solve the puzzle.

Experimental subjects worked that solving the puzzle for 30 minutes, whereas a control group did light reading in a quiet room for the samne amount of time. After the initial 30 minute period, subjects were told to wait outside in a hallway until the second part of the experiment began. While subjects were waitng, a female confederate walked by and dropped an armful of papers and books onto the floor in front of the subject. The percentage of subjects who help the confederate pick up her book was recorded for wach group. The results showed that 60% of the control subjects helped the confederate whereas only 30% of the subjects in the noise conditions offered to help. No difference was found between the 20 and 40 dB noise levels.

The experiment concluded that the presence of the white noise served to increase frustration, therefore producing a decline in helping behavior. The experimenter further stated that it was only the presence of the white nosie that

mattered, and not the intensity of the noise. Do you agree or disagree with the experimenter's conclusions? How would you design an experiment to test the hypothesis?

MULTIPLE CHOICE QUESTIONS

1. Which of the following is **not** true concerning social psychology?
   a. Social psychology is the study of the effects of other people on the behavior of the individual.
   b. There are often problems in gaining experimental control in social psychologyexperiments.
   c. The topics of social psychology may not be studied in the field due to problems of demand characteristics.
   d. Experimenter bias can be a problem in social psychology research.
2. As a group social psychologists believe that:
   a. social psychology should be studied experimentally.
   b. behavior is largely due to instincts.
   c. social influence is an important determinant of behavior.
   d. both a and c.
3. If after viewing a stationary light for a period of time the light appears to move by itself, you are experiencing a _____.
   a. perceptual illusion
   b. social norm
   c. psychokinesis
   d. conformity effect

4. Sherif (1935) found that a subject's judgments of how a stationary light seemed to move:
   a. depended upon the illumination level of the experimental chamber.
   b. were influenced by the judgments of other observers.
   c. provided no evidence for social norm effects.
   d. were produced by demand characteristics of the experimental situation.5. Asch's experiments on conformity as evidenced by visual discrimination:
   e. employed a task where subjects judged which of three lines was closest in length to a standard.
   f. used groups of people composed of several confederates and only one real subject.
   g. showed that subjects will conform to the consensus of the group even when their own perceptions tell them otherwise.
   h. all of the above.

6. The experiment in which Asch required a subject in a group setting to estimate which of three comparison lines matched a standard line was conducted in order to study _____.
   a. visual discrimination
   b. conformity
   c. ambiguous perceptions
   d. memory

7. Which of the following is least likely to be manipulated as an independent variable in a social psychology experiment?
   a. stimulus intensity
   b. the sex of the subjects
   c. number of confederates present
   d. the race of the subjects

8. In an experimental design the factor that is manipulated is called the _____ variable and the behavior that is measured is called the _____ variable.
   a. independent; dependent
   b. dependent; independent
   c. dependent; control
   d. independent; control

9. Experimental control:
   a. allows the experimenter to be certain that a change in the dependent variable is due to manipulation of the independent variable.
   b. is harder to acquire as the experimental situation becomes more complex.
   c. is usually a greater problem in field research than in laboratory work.
   d. all of the above.

10. An experimenter was interested in studying sex differences in the effects of sleep deprivation on the performance of vigilance tasks. He tested a group of males and a group of females on a vigilance task at various phases of sleep deprivation. He found that after 24 hours of sleeplessness the males made more errors on the vigilance task than the females. However, after 72 hours of sleep deprivation the two groups made an equal number of errors on the task. In this experiment _____ was the dependent variable.
   a. the sex of the subjects
   b. number of errors on the vigilance task
   c. number of hours of sleeplessness
   d. both a and c

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   a. the sex of the subjects
   b. number of errors on the vigilance task
   c. number of hours of sleeplessness
   d. both a and c

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    a. Men need more sleep than women.
    b. Women perform better on vigilance tasks than men.
    c. Women initially suffer less from sleep deprivation than men, but this difference disappears after 72 hours.
    d. all of the above.

13. If some factor is unintentionally covaried with the factor of interest in an experiment, then the two factors are said to:
    a. be correlated
    b. interact
    c. be confounded
    d. result in main effects

14. If some factor in unintentionally covaried with the factor of interest in an experiment we:
    a. can still conclude that the factor of interest produced the experimental result because it was under experimental control.
    b. must conclude that the unintentionally manipulated variable produced the experimental effect.
    c. must conclude that both factors in combination produced the experimental result.
    d. none of the above.

15. Factors that are held constant across experimental conditions are called _____ variables.
    a. control
    b. independent
    c. dependent
    d. confounded

16. Randomization:
    a. is appropriate only in between-subjects designs
    b. is one way to avoid confounding
    c. is the control of an independent variable across experimental conditions
    d. both *a* and *b*

17. Milgram's (1963) first study conducted at Yale on how far subjects would go in giving electric shocks to another "subject" would best be described as:
    a. an experiment because he used a controlled laboratory setting
    b. a demonstration since there was no manipulation of the independent variable
    c. a quasi-experiment since subjects were not randomly assigned to conditions
    d. a survey because subjects from all walks of like were tested

18. Milgram's obedience studies showed that:
    a. a high number of subjects gave the confederate the full series of shocks even though they felt anxious about doing so
    b. very few subjects complied with the experimenter's instructions
    c. very few confederates complied with the experimenter's instructions
    d. the confederates performed better on the learning task when given electric shock

19. In Milgram's obedience study in which he varied closeness of the subject to the victim he found that:
    a. the degree of closeness had no effect on the number of subjects that finished the experiment
    b. the degree of closeness had a powerful effect as no subject would complete the experiment in the condition that required the closest contact
    c. the degree of closeness had an effect, but even in the condition that required the greatest contact almost a third of the subjects completed the experiment
    d.. the effect of degree of closeness was uninterpretable due to floor effects

20. Which of the following variables has been found to effect obedience to authority?
    a. presence of other subjects who refuse to cooperate
    b. presence of other people who encourage the subject to continue
    c. closeness of the subject to the victim
    d. all of the above

21. Experimenter bias:
    a. is much more prevalent in the physical sciences than in the social sciences
    b. often produces placebo effects
    c. may occur without the experimenter's conscious awareness
    d. none of the above

22. Demand characteristics:
    a. are a result of confounded variables
    b. are a less powerful source of bias than experimenter bias
    c. are cues that govern a subject's behavior in an experimental setting
    d. do not operate in simulated control groups

23. If the results of an experiment are produced by the demand characteristics of the experimental setting then:
    a. the randomization procedure was unsuccessful
    b. they may not generalize to other settings
    c. the experimenter purposefully biased the outcome
    d. all of the above

24. The placebo effect is related to the problem of _____.
    a. experimenter bias
    b. confounded variables
    c. demand characteristics
    d. conformity

25. The largest problem with field research is the lack of _____.
    a. control
    b. generalization
    c. confounding
    d. randomization

26. With respect to the phenomenon of bystander intervention, what is meant by the term "diffusion of responsibility"?
    a. a tendency for all bystanders to accept responsibility for the person in trouble
    b. a tendency for each bystander to feel increased responsibility as the number of bystanders increase
    c. a tendency of bystanders to aid the person in trouble due to a fear of "losing face" from failing to help
    d. a tendency for each bystander to feel less responsible for helping the victim as the number of bystanders increases

TRUE-FALSE QUESTIONS

____ 1. The purpose of introducing experimental control is to understand how some factor(s) produce a particular effect.

____ 2. The problem of generality of results is often greater in field research than in laboratory work.

____ 3. The view that behavior is instinctive has been largely abandoned by social psychologists.

____ 4. Social norms are generalized rules that dictate our behavior in social situations.

____ 5. In his experiments using the autokinetic phenomenon, Sherif was mainly interested in the perception of visual illusions.

____ 6. Sherif's work with the autokinetic phenomenon showed that the influence of social norms cannot be studied experimentally.

____ 7. Sherif's findings that perceptions were influenced by social norms did not generalize to other situations.

____ 8. Asch was able to show conformity behavior in an unambiguous visual discrimination task.

____ 9. There is no point in studying the topics of social psychology in experimental settings because it is impossible to gain control over the situations considered.

____ 10. A dependent variable may be systematically varied by the experimenter.

____ 11. Independent variables are held constant across all experimental conditions.

____ 12. Experimental control is achieved when the experimenter is sure that a change in the dependent variable is due to manipulation of the independent variable.

____ 13. Confounding is one main source of experimental error.

____ 14. Control variables are changed across experimental conditions to assure randomization.

____ 15. Confounding occurs when two variables are intentionally covaried across experimental conditions.

____ 16. Experimental error due to confounding may be reduced through the randomization of uncontrollable factors across experimental conditions.

____ 17. In Milgram's obedience studies the subject was the teacher and the learner was a confederate.

____ 18. Subjects in Milgram's study on obedience obeyed the experimenter only because the experiments was conducted at a prestigious institution.

____ 19. Experimenter bias may be either intentional or unintentional.

____ 20. Field research is fraught with problems of demand characteristics.

____ 21. Placebo effects are analogous to demand characteristics.

____ 22. Orne and Evans (1965) showed that results previously attributed to hypnosis were probably due to demand characteristics.

____ 23. Although there are few concerns with generality of results in field research there are many serious problems concerning experimental control.

____ 24. Field research has shown that when the victim is believed to be ill bystanders are more likely to help a victim of their own race than a victim of a different race.

ESSAY QUESTIONS

1. Briefly discuss the findings of Sherif and Asch on conformity. Which set of results is more convincing? Why?
2. Why is subject bias more of a problem in laboratory research than in field studies?
3. What is bystander intervention? What factors seem to effect intervention behavior?
4. If you were going to conduct a field study on bystander intervention what factors would you try to control?

Chapter 14

Environmental Psychology

IN OTHER WORDS

Environmental psychology has been defined as an interdisciplinary study of human behavior and well being in relation to the sociophysical environment. The environmental psychologist is both trying to solve real world problems and to conduct research that will lead to correct conclusions about behavior in the real world.

A major issue in environmental psychology is conducting **representative** research so that the results and conclusions can be generalized to other situations. **Generality of results** requires that the sample of subjects be typical of a target population (**sample generalization**). Generality of results is also concerned with the appropriateness of the independent and dependent variables (**variable representativeness**). There should be a meaningful correspondence between situations for independent variables (various ways of inducing stress, for example) and for dependent variables (various ways of measuring aggression).

Four studies of crowding were discussed in terms generality of results. Calhoun, in the laboratory, studied **crowding** in rats. He found high mortality rates in compartments that had the greatest crowding and various forms of pathological behavior.

Galle, Glove, and McPherson, measured various forms of **social pathology** as a function of crowding in a correlational study conducted in Chicago. Initially, they measured crowding by **density**, the number of people per acre. They found that density correlated positively with each form of social pathology, but when the results were re-analyzed with a **partial correlation** technique to statistically remove the effects of social class and ethnicity, the relationship between density and social

pathology disappeared. Finally Galle and his co-workers obtained other measures of crowding, and by combining them through the procedure of multiple correlation, found evidence for a positive correlation between a composite measure of crowding and incidence of social pathology, even when the effects of social class and ethnicity were statistically controlled.

Saegert, Macintosh, and West studied the effects of crowding on performance and affect. They tested their subjects in a train station at two different times of the day, when the density of people were quite different. They found that their subjects accomplished fewer tasks in a given time, and felt more anxious and skeptical in the more crowded condition.

Marshall and Heslin studied crowding in humans in a laboratory setting. They obtained various measures of affect from their subjects who were tested in on of two group sizes (4 vs. 16 people), under one of two levels of space (4 vs. 18 square feet per person), and in single sexed vs. mixed sexed groups. They found that males preferred to be in the mixed-sex groups, and preferred crowded groups, but were uninfluenced by the size of the group. Females preferred large to small mixed-sex groups, but small to large groups of all females. The differences among the results of these studies indicate the difficulty in establishing generality of results for the effects of crowding.

Performing different types of experiments to jointly support a single concept is to use **converging operations**, which is an excellent way to increase the generality of results. Two studies of **personal space** were considered to illustrate this concept. Kinzel operationally defined personal space in a study in which a subject was approached by an experimenter from eight different directions until the subject said "stop." Kinzel found that violent prisoners said "stop" at greater distances than nonviolent prisoners, and thus have larger personal spaces. Barefoot and co-workers explored the same phenomenon of personal space but gave it a different operational definition. People were required to enter the personal space of the experimenter if they wished to gain access to a water fountain. It was found that increasingly more people drank water as the experimenter was moved further from the fountain. The concept of personal space seems to explain both findings; the buffer zone around people seems to influence behavior whether they intrude on the space of others, or vice versa.

Finally, psychologists are very concerned with the **ethical issues** involved in testing human subjects. The principle of **informed consent** means the potential participants in a experiment are given the opportunity to decline to participate in the research. The ethical issues of research with human subjects presents a very real

and difficult dilemma for the environmental psychologist, since in many situations **deception** of the subject seems to be necessary in order to avoid reactivity.

KEYWORD MATCHING

1.

____converging operations
____generality of results
____informed consent
____partial correlation
____sample generalization
____variable representativeness

A. different types of experiments that support a single concept
B. ethical guideline that a subject can refuse to participate in an experiment
C. independent and dependent variables have appropriate counterparts in another situation
D. results and conclusions that apply in other situations
E. statistical removal of effects of control variables
F. subjects are representative of people in a different situation

2.

____crowding
____deception
____density
____personal space
____representativeness
____social pathology

A. another name for generality of results
B. hypothetical buffer zone surrounding a person
C. increased death rate, decreased fertility rate, increased public assistance rate, increased juvenile delinquency, increased admission to mental hospitals
D. leads to deviant behavior, lowered performance, or changes in affect in different situations
E. one means of measuring crowding
F. violation of ethical standards often employed to reduce reactivity

PROGRAMMED REVIEW

1. One primary advantage of the scientific method over astute natural observation is that the scientific method is _____ correcting.

2. In addition to observable behavior, environmental psychologists often record _____ and _____. These internal states are inferred from _____.

3. The independent variable density is generally defined as the _____ of people per unit _____.

4. Density can be manipulated by (a) varying the _____ of _____ and holding room _____ constant, and by (b) varying _____ _____ and holding the _____ of people constant.

5. Besides density, another set of independent variables studied by environmental psychologists are _____ such as loud noise or high temperature.

6. Experiments that allow us to extend their findings to more general situations than only the particular combination of subjects and variables used in that experiment are said to be _____ experiments.

7. The problem of generalizing from one group of subjects to a different group is call the problem of sample _____.

8. Variable _____ refers to the problems about generalizations of experimental manipulations and the measures of behavior used.

9. As a result of the problem of establishing variable representativeness, many environmental psychologists have turned away from laboratory studies and have begun conducting _____ _____.

10. In Calhoun's (1962, 1966, 1971) studies on the long-term effects of crowding in rats, the independent variable was _____ and the dependent variables were _____ and _____ behaviors.

11. In trying to generalize Calhoun's results showing that high density causes pathological behavior, we are faced with the problem of _____ generalization.

12. If we wanted to examine the effect of crowding on human behavior we could observe behavior patterns in parts of cities that differ in population density. The advantage of this type of study is that there is little difficulty in _____ _____. The disadvantage is that there is almost no experimental control over the _____ variable.

13. When tight experimental control is not possible one solution is to employ _____ control.

14. Galle, Gove, and McPherson (1972) used the statistical technique of _____ in their study of crowding and social pathology. The difficulty with this statistical technique is that it is difficult to reach conclusions about _____ with this type of data.

15. In their study, Galle et al. (1972) tried to remove the effect of social class and ethnicity by using the statistical technique of _____ correlation.

16. In the Saegert, Mackintosh, and West (1975) study, the independent variable was _____ and one of the dependent variables was the number of _____ completed in a 30 minute period. The other dependent variable was how subjects rated their _____ after the 30 minute period.

17. In the study by Marshall and Heslin (1975), density was manipulated in two ways. This gives the results of this study greater _____ representativeness than if density had been manipulated in only one way.

18. If Marshall and Heslin (1975) had used only male subjects and had tried to generalize their results to females, the conclusions drawn may have been incorrect. By including both males and females Marshall and Heslin's study achieved greater _____ generalization than a comparable study employing only males or only females.

19. In Kinzel's (1970) study on personal space, the dependent variable was _____

_____

_____

20. Barefoot, Hoople, and McClay (1972) found that _____ people stopped to drink water when the experimenter sat close to the fountain than when he sat far from the fountain.

21. The right of _____ consent means that potential participants in an experiment are given an explanation of all salient features of the research and are allowed to decline to participate in the research.

22. In situations in which people do not know that they are participating in an experiment, it is important that the potential _____ of the research exceed the potential _____ to the participants.

EXPERIMENTAL PROJECT

The participants in many environmental psychology studies are unaware that they are being observed. In this project your participant will not be aware that he or she is being observed. Therefore, it is your responsibility to ensure that the potential gains from conducting this project exceed any potential harm that might be done to your participant. Actually, there is very little risk of any harm in your participant, but, nonetheless, it is up to you to make sure that (a) you are reasonably sure that this project is safe for your participant, and (b) that after completing this project you discuss completely with your subject what this project was about.

One way to demonstrate the concept of personal space is to see how people react when you violate their personal space by moving very close to them. A typical reaction is to back away from the person who has violated your personal space. In order to demonstrate this, engage a friend in a conversation while you are standing in some fairly open space. during the conversation try to move slowly closer to your friend. How close can you get before your friend begins to move away or react in some other fashion? Can you obtain an estimate of the "size" of your friend's personal bubble? Is it the same size in all directions (e.g., front, side) or does the size depend upon the position of the "intruder"?

EXPERIMENTAL DILEMMA

A medical investigator had several reasons to believe that drinking excessive quantities of coffee would lead to prostrate cancer in adult males. In order to test this hypothesis he selected a sample of patients who had prostrate cancer and then matched these patients with other patients in the hospital who had similar backgrounds (e.g., age, weight, type of physical activities engaged in). After these two groups of patients were matched, the researcher determined for each patient how much coffee was consumed on average each day.

The results showed that the prostrate cancer patients consumed reliably more coffee ($p<.01$) than did the patients who did not have prostrate cancer. Based on this relation the researcher concluded that excessive coffee drinking causes prostrate cancer.

Do you agree or disagree with this conclusion? Why or why not?

MULTIPLE CHOICE QUESTIONS

1. Cohen et al. (1973) found that children who lived on lower floors of an apartment building built directly over a busy freeway, when compared to those children living on higher floors, were:
   a. more irritable
   b. more active
   c. more aggressive
   d. poorer readers

2. In an experiment examining the effects of crowding, density can be manipulated by:
   a. varying the number of people and holding the room size constant
   b. varying the room size and holding the number of people constant
   c. selecting parts of a city with either a high or low population density
   d. all of the above
   e. both *a* and *b*

3. An important criterion for judging the utility of an experiment is its':
   a. representativeness
   b. objectivity
   c. validity
   d. reliability

4. The problem of generalizing results from one subject group to a different subject group or to a different population is termed:
   a. variable representativeness
   b. variable generalization
   c. sample reliability
   d. sample generalization

5. The problem of whether environmental stress induced by increasing room temperature of by increasing noise level is the same is a specific example of the more general problem called:
   a. sample generalization
   b. variable reliability
   c. variable representativeness
   d. variable validity

6. In a study concerned with the effect of high temperature on aggression, Baron and Bell (1976) found that high temperatures do not necessarily lead to increased aggression. If one attempted to generalize this result to an urban setting it might be concluded that long hot summers do not lead to aggression. This illustrates the general problem of:
   a. incorrect interpretations of the results of a laboratory experiment
   b. variable representativeness
   c. subject generalizability
   d. in inappropriate inference based on data from flawed experiment

7. Many environmental psychologists have turned away from laboratory studies in favor of field research because with a laboratory study there is considerable difficulty in establishing:
   a. variable representativeness
   b. sample generalizability
   c. experimental reliability
   d. experimental control

8. Calhoun's studies on crowding with rats found that all but one of the following to be a result of excessive crowding. The exception is:
   a. cannibalism
   b. sexual aberration
   c. greater sociability
   d. higher infant mortality

9. In Calhoun's studies on crowding with rats, the male rats that showed highly abnormal behavior patterns were called:
   a. sociopaths
   b. probers
   c. overdominant
   d. obsessive-compulsive

10. Which of the following measures of density was **not** used in the Galle et al. (1972) study?
   a. number of persons per room
   b. number of rooms per housing unit
   c. number of residential structures per acre
   d. number of persons per acre
   e. all of the above were used

11. The basic difficulty with correlational studies is that:
    a. one can never make firm conclusions about relationships
    b. one can never reach conclusions about causation
    c. one cannot statistically test the significance of correlational results
    d. all of the above

12. A study that _____ permits statements about causation:
    a. manipulates the independent variable
    b. exhibits a high degree of variable representativeness
    c. exhibits a high degree of subject generalizability
    d. all of the above
    e. both *b* and *c*

13. Marshall and Heslin (1975) varied the sex of subjects and the size of the group in an experiment that measured the feelings of the subjects toward the group. They found that:
    a. females liked small groups more than large groups only if the group was of mixed sex
    b. females, while preferring mixed sex groups, did not care much about group size
    c. if the group was all female, females preferred the large group
    d. all of the above
    e. both *a* and *b*

14. The technique of using slightly different types of experiments to jointly support a single concept is called:
    a. experimental representativeness
    b. experimental generality
    c. converging operations
    d. converging comparisons

15. Kinzel (1970) found that violent prisoners have:
    a. larger personal space bubbles than nonviolent prisoners
    b. smaller personal space bubbles than nonviolent prisoners
    c. a larger personal space area in front of them than behind
    d. both *a* and *c*

16. In approaching a violent prisoner, you wouid be more likely to invade his personal space if you approached from the prisoner's:
    a. left side
    b. right side
    c. front
    d. rear

17. One important principle advocated by the American Psychological Association is the right of informed consent, which states that the experimenter has a clear obligation to:
    a. obtain approval from a committee that judges the ethics of proposed research before performing an experiment involving human subjects.
    b. balance the potential worth of the research involving human subjects.
    c. explain to subject all salient features of the research before the experiment is conducted to allow the subjects the opportunity to decline from participating
    d. all of the above

TRUE-FALSE QUESTIONS

____ 1. Accepting the scientific method implies that one assumes that other methods for arriving at truth are invalid.

____ 2. Experiments that are reliable allow us to extend the implications of their findings to more general situations than only that particular combination of subjects and treatment variables used within the experiment.

____ 3. The problem of generalizing results from one sample to a different sample has been termed sample generalization, and the problem of generalization of independent and dependent variables has been called variable representativeness.

____ 4. Calhoun found that the long-term effects of crowding in rats included cannibalism and homosexuality.

____ 5. Variable representativeness refers to the degree of generality of results across different manipulations of an independent variable or different dependent variables.

____ 6. In Calhoun's study on the effects of crowding on rats, "probers" were adult male rats who would pursue female rats into their burrow and eat the dead infant rats found there. Probers were also homosexual and hyperactive.

____ 7. Psychologists call the technique of using slightly different types of experiments to jointly support a single concept converging operations.

____ 8. The principle of informed consent requires an experimenter to obtain approval from a committee that judges the ethics of proposed research before performing an experiment involving human subjects.

ESSAY QUESTIONS

1. What is the problem of sample generalization? Why is this a serious problem for environmental psychologists?

2. Why would a scientist be reluctant to accept Jane Jacobs' conclusions about the function of city sidewalks? What might convince a scientist that these conclusions are valid?

3. Why are psychologists concerned with the issue of ethics? What steps do psychologists take to help ensure that their research is ethical? Which experiments pose the greatest ethical problems, and how do psychologists decide whether or not to conduct such experiments?

Chapter 15

Human Factors

IN OTHER WORDS

This chapter describes how findings from the experimental psychology laboratory have been applied to solving practical problems. **Human factors** is the discipline that seeks to optimize the relationship between technology and the human. The most important tenet of human factors is to "Honor thy User." This means that the technology should be designed for the capabilities and habits of the particular people who will be using it. The chapter describes several studies in human factors research to illustrate various experimental topics.

A study of dynamic visual acuity was used to illustrate **small-n designs**. Only two subjects were used in this research, but each subject served in more than forty 40- to 60-minute experimental sessions. **Dynamic visual acuity** is the ability to see detail in moving objects. In this study, visual acuity was measured with a **Landot C** which is a circular stimulus with an adjustable gap. Subjects were required to report the position of the gap, and the **method of limits** was used to find the minimum gap that permitted accurate localization. Several independent variables were included in the study, including color of the ring, angular velocity of the stimulus, and whether the target was viewed in dim light (**scotopic vision**) or bright light (**photopic vision**). The results indicated that thresholds were smaller with low rather than high velocities, with photopic rather than scotopic vision, and that blue color allowed greater acuity than other colors under scotopic, but not photopic viewing conditions.

A series of studies was conducted at NASA to find an objective measure of of the attentional and cognitive demands, or **workload**, that different flights, and different stages of a flight placed on pilots. Workload was traditionally assessed with **subjective measures**; pilots would rate the workload at various times during or after flights. Pilots typically reported that the landing phase was the most demanding, but an objective measure of workload was sought to provide converging support for this

conclusion. Experiments were conducted in a flight simulator, and experienced pilots were used as subjects. A **secondary task** was introduced to the situation. The subjects' main responsibility was to control the flight simulator; he was to perfom the secondary task as well as possible, but not at the expence of the primary task. It was expected that as workload increased, performance on the second task would deteriorate, and this decline in performance would provide an objective measure of workload. The secondary task that was used was a **choice-reaction task**, in which the pilot had to move a switch in a particular direction, depending on the frequency of a tone. The results of this study were that the objective measure of workload appeared to be sensitive, and to agree with the subjective measure, thus providing converging measures for workload.

Two studies of traffic safety were presented. The first illustrated the use of **verbal report** in monitoring the driving performance of older drivers. Drivers between the ages of 40 and 49 were compared with drivers more than 50 years old. Each driver in the samples filled out a Daily Driver Checklist (DDC) each day for a three month period. Although age-related decrements were found in sensory, cognitive, psychomotor, and physical functioning, there was no relationship between age and driving performance as measured by the DDC.

A second study of traffic safety was an example of **field research** in human factors. A total of 2,100 taxicab drivers from Washington D.C. were divided into four equally sized matched groups. Members of each group were provided with cabs with one of four brake light configurations. The number of rear-end collisions was monitored over a 12-month period. The results indicated that cabs with centered high-mounted brake lights experienced fewer rear-end collisions than cabs with other configurations. The authors concluded that centered high-mounted brake lights were closer to the following driver's **normal line of regard**, and that brake lights that were more easily seen were more effective in preventing accidents.

KEYWORD MATCHING

1.

_____choice reaction task
_____dynamic visual acuity
_____Landot C
_____normal line of regard
_____photopic vision
_____scotopic vision
_____workload

A. ability to see detail in moving stimuli
B. circular stimulus with an adjustable gap
C. cognitive and attentions demands produced by a task
D. direction in which people normally look
E. making a particular response depending on which stimulus is presented.
F. nighttime vision
G. vision under daylight conditions

2.

_____field research
_____human factors
_____method of limits
_____objective measures
_____secondary task
_____small-n design
_____subjective measures

A. deterioration of performance on this is a measure of workload
B. few subjects each contribute many measures
C. psychophysical method of determining thresholds
D. research conducted in a natural environment
E. study of man-machine relationship
F. verbal report
G. verifiable measure of behavior

PROGRAMMED REVIEW

1. Human factors is the discipline that attempts to optimize the relationship between _____ and the _____.

2. The first commandment of human factors is _____ _____ _____.

3. The most common dependent variable in human factors research is _____.

4. Human factors researchers employ a (wider/narrower) _____ range of independent variables than do experimental psychologists.

5. In general, field research has (more/fewer) _____ control variables than does laboratory research.

6. The ability to perceive detail in moving objects is known as _____ _____ _____.

7. A stationary Landolt C is used to measure _____ visual acuity.

8. Blue color receptors differ from other color receptors in that they have _____ static acuity.

9. Night viewing conditions rely on _____ vision whereas viewing in bright daylight relies on _____ vision.

10. In a dual task experiment, the performance levels on the _____ task are used to assess the amount of attention required by the task of interest.

11. In a valid secondary task experiment, insertion of the secondary task (should/should not) _____ affect performance on the primary task.

12. A reaction time task with one stimulus and one response is called a _____ reaction task; a task with several stimuli and several responses is known as a _____ reaction task.

13. The results of the experiment measuring pilot workload in the NASA Kuiper Airborne Observatory showed that the pilots exhibited a (higher/lower) _____ mean heart rate than did the copilots.

14. The Driver's Daily Checklist study of driving perfomance in older drivers used a(n) _____ _____ as a measure of driving performance.

15. The study on brakelight configuration is an example of _____ research.

EXPERIMENTAL PROJECT

This project will allow you to examine some of the problems associated with collecting subjective estimates of mental workload. First, make up a list of possible dimensions on which the mental workload associated with driving might be measured (e.g., visual difficulty, decision making). After you have constructed your list, you will attempt to see if the list can be used to differentiate two hypothetical driving scenarios, one that seems a priori to be difficult and another that seems easy.

Your tasks in this project are threefold. First, you are to design a carefully controlled study that will allow you to assess the utility of your list of mental work load

attributes. In doing so, be careful to note these aspects of research methodology that are relevant to conducting this study. At the very least you should specify the independent, dependent and control variables involved. Will your study be a within-subject design or between subject? How will you analyze your data?

The second task is to conduct a small pilot study using your research plan. After collecting data from a small number of subject, reassess the methodology you started with. Are there any changes that you would make now that you have had some experience testing subjects?

Finally, how confident are you about using verbal estimations of mental workload? Which method do you think is more valid, yours or the methodology described in the text? Could you possible combine the two approaches?

EXPERIMENTAL DILEMMA

A scientist conducted a secondary task investigation of the mental workload associated with using a word processor. His primary task was word processing and his dependent variables were the time taken to make changes in a copyedited manuscript as well as the number of typing errors made. (These data were collected by a computer program). His secondary task was a visual choice reaction time task with two levels of difficulty. In the easy condition a light appeared in the upper right or upper left corner of the video monitor and the subjects task was to press one of two buttons on a response box alongside the keyboard. In the difficult condition a light could appear in any one of the four corners of the display and again the task was to press one of the four buttons on the response box.

Results showed that subjects were slower to respond to the difficult secondary task than to the easy secondary task. However, subjects made in the same number of errors and took the same time to complete the copyediting task in both the easy and difficult secondary task conditions.

Given these results, what can/should the researchers conclude? There are at least two major problems with this design - what are they? How would you design an experiment to answer the question of interest?

MULTIPLE CHOICE QUESTIONS

1. Human factors researchers must know about the _____ in order to follow the first commandment of human factors.
   a. technology
   b. user population
   c. company policy
   d. relevant engineering discipline

2. Two of the primary dependent variables used in human factors research are:
   a. time and cost
   b. time and error rates
   c. system efficiency and liability
   d. system reliability and performance validity

3. Which of the following would a human factors researcher use as independent variables?
   a. communications among individuals
   b. noise
   c. vibration
   d. subject variables
   e. all of the above

4. Dynamic visual acuity can be measured using a(n):
   a. Snelling chart
   b. stationary Landolt C ring
   c. moving Landolt C ring
   d. occulometer

5. A person attempting to locate a buoy at sea on a dark night would be using their?
   a. scotopic vision
   b. photopic vision
   c. iconic vision
   d. cones

6. In an ideal experiment using a secondary task methodology, the secondary task would:
   a. change performance levels on the primary task
   b. not alter performance levels on the primary task
   c. be more difficult than the primary task
   d. result in constant levels of performance on the secondary task

7. One dependent variable that takes into account both response speed and response accuracy is:
   a. number of correct responses per unit time
   b. total number of responses per unit time
   c. bits per unit time
   d. none of the above

8. In Experiment 1.0, Kantowitz, Hart and Bartulussi (1983) found that:
   a. performance levels on the secondary task were the same for the easy and difficult flight scenario
   b. performance levels on the primary task were equivalent on the easy and difficult flight scenario
   c. performance levels on the primary task were different on the easy and difficult flight scenario
   d. both a and c

9. In the comparison of driving performance of drivers in their forties, and those fifty or older, it was found that sensory and cognitive functioning _____ and that driving performance _____ with age.
   a. did not change; did not change
   b. declined; did not change
   c. did not change; declined
   d. declined; declined

10. In the study of traffic safety and brakelight configuration, _____ was the dependent variable.
   a. brakelight configuration
   b. accident rate of the drivers
   c. number of rear-end collisions
   d. workload

TRUE-FALSE QUESTIONS

____ 1. Human factors researchers generally employs a narrower range of independent variables than do experimental psychologists.

____ 2. Red color receptors have lower visual acuity than do blue color receptors.

____ 3. Photopic vision is controlled by the cones and is utilized in bright daylight viewing conditions.

____ 4. Data from small-n research projects are generally averaged together so as to decrease variability across subjects.

____ 5. The difficulty of a primary task can be indirectly assessed by examining performance levels on a secondary task.

____ 6. Reaction time and response accuracy are examples of subjective dependent variables.

____ 7. In the first pilot mental workload experiment described in the text, the data showed that the objective and subjective dependent variables gave converging results.

____ 8. Research has shown that it is more important for older drivers to have center-mounted brakelights than it is for younger drivers.

ESSAY QUESTIONS

1. How is dynamic visual acuity different from static visual acuity? What factors might one want to control or manipulate in an experiment assessing visual acuity.

2. Describe the logic behind the secondary task methodology, using a hypothetical experiment to illustrate the logic. What assumptions must be made to employ this methodology and under what conditions might these assumptions prove to be invalid?

3. What are some of the main differences between doing basic research in a university laboratory vs. field research in an applied setting?

Appendix A

Experimental Psychology: A Historical Sketch

IN OTHER WORDS

Experimental psychology is a relatively young science. Wilhelm Wundt was the first person to call himself a psychologist, and in the 1870's published a text on physiological psychology, and established the first psychology laboratory in Leipzig. The roots of psychology however, extend much further back in time, and lie in the questions asked by many generations of philosophers, such as the nature of and relationship between mind and body, the nature of thought, and the role of experience in understanding the world. One philosophic position, **dualism**, held that mind and body were different sorts of things and governed by different laws; since the mind possesses free will, it makes no sense to study it scientifically. Physiology and physics provided the first scientific tools that were used in the study of psychological questions, especially questions that concerned sensory processing of physical stimuli. Four early pioneers of experimental psychology were Helmholtz, Weber, Fechner, and Ebbinghaus.

Herman Helmholtz is credited with conducting transitional experiments between physiology and psychology. A particularly noteworthy example is his use of **reaction-time experiments** to estimate the speed of nervous conduction. He found that people took longer to respond to stimuli delivered to their ankles than to their shoulders, and from the difference in reaction times he was able to calculate a fairly accurate measure of the rate of nervous conduction.

Ernst Weber while studying the skin senses, discovered that the minimum change in stimulus intensity that could be reliably detected, the **just-noticeable**

difference, was a constant fraction of the magnitude of the standard stimulus intensity. This finding was later to be known as **Weber's law**.

Gustav Fechner incorporated Weber's law, and elaborated on it in his investigation of the relationship between stimulus intensity and sensation magnitude, a discipline known as **psychophysics**. Fechner found that the magnitude of sensation was a function of the log of the stimulus intensity, a relationship that is now known as **Fechner's law**.

Hermann Ebbinghaus is credited with extending the experimental approach to the areas of learning and memory.

Between the years of 1890 and 1940, various schools of psychology arose. The structuralist school was founded by Wundt, and is also associated with Tichener who brought this view to the United States. **Structuralism** was concerned with the structure of the mind, and the elements of experience. The basic elements of experience were thought to be **sensations**, **images** or **ideas**, and **affections** or emotional responses. Structuralists were trained to report the elemental components of complex experiences, using a method known as **introspection**. A failure to report an experience in terms of its elements came to be known as the **stimulus error**.

Functionalism, founded by John Dewey, arose in part as a reaction against structuralism, and the sterility and unreliability of introspection. Functionalists were concerned with the functions of various mental structures and processes, in much the same spirit that Darwinians were concerned with the functions of biological structures and processes.

Behaviorism, founded by John Watson, was a reaction against both structuralism and functionalism. Behaviorists believed that scientific psychology should be based on observable behavior, and that mentalistic concepts had no place in a natural science. Behaviorists considered that most important behaviors were learned, so learning became the focus of interest.

The **Gestalt** school arose as yet another reaction to structuralism. Gestalt psychologists argued that perception was of the whole, and not of a collection of mental elements; that the whole was more than, and different from, the sum of the parts. The Gestalt school is associated with many demonstrations of perceptual phenomena. One demonstration was of **shape constancy**; people perceive an object to have an unchanging shape despite changes in the retinal image produced by changing the point of view. Although Gestalt psychology has not been integrated into the mainstream of experimental psychology, its influence in the area of

contemporary **cognitive psychology** is great, especially in the areas of perception and problem solving.

The era of schools of psychology declined around 1940. Since that time psychology has become increasingly specialized; there are now some 45 divisions within the American Psychological Association. World War II had a tremendous impact on psychology; psychologists filled many different roles which ultimately led to an expansion of the field, the development of new disciplines, and the application of experimental methods to new problem areas. The decline of behaviorism was accompanied by a "rediscovery" of the mind; modern cognitive psychologists have devised clever techniques to investigate mental processes, and have incorporated modern technology in their research, such as **information theory** which was developed during World War II, and many of the fruits of computer science. Study of the mind is also the goal of **psychophysiology** which seeks to find physiological correlates of psychological phenomena, and to develop psychological models from knowledge of physiological states.

KEYWORD MATCHING

1.

_____behaviorism
_____cognitive psychology
_____functionalism
_____Gestalt psychology
_____information theory
_____psychophysics
_____psychophysiology
_____structuralism

A. contemporary field of psychology interested in mental processes
B. developed from engineering; benefits cognitive psychology
C. developed many demonstrations of perceptual phenomena
D. school concerned with elements of experience
E. school founded by Dewey, influenced by Darwin
F. school that emphasized study of the observable, interested in learning
G. seeks physiological correlates of psychological phenomena
H. study of relationship between physical stimuli and psychological responses

2.

____affections
____dualism
____ideas
____sensations

A. belief that mind and body are governed by different laws
B. emotional elements of experience
C. images; elements of experiences not present
D. sights, sounds, etc.; elements of experience

3.

____Fechner's law
____introspection
____just-noticeable difference
____reaction-time experiment
____shape constancy
____stimulus error
____Weber's law

A. perception remains unaltered despite changes in retinal image
B. relates size of jnd to standard stimulus
C. relates stimulus intensity and sensation magnitude
D. research technique used by structuralists
E. research technique used by Helmholtz to measure speed of neural conduction
F. smallest detectable change in stimulus instenity
G. what good structuralists never commit

PROGRAMMED REVIEW

1. _____ suggests that the body is controlled by physical laws, but the mind is not, since it has free will.
2. The British empiricist philosophers emphasizes the role of _____ in coming to understand the world.
3. Helmholtz performed a _____ _____ to measure the speed of the _____ _____.
4. Weber found that the size of the _____ was a constant proportion of the standard stimulus.
5. The study of the relationship between stimulus intensity and sensation magnitude is called _____.
6. In developing his famous psychophysical law, _____ elaborated on Weber's law

7. _____ is credited with establishing the first laboratory of psychology, and with founding the _____ school of psychology.
8. _____ was the first to demonstrate that learning and memory could be studied scientifically.
9. The _____ school of psychology was interested in determining the elements of experience.
10. _____ is the name of the research technique employed by the structuralists.
11. If you called a spade a spade, a structuralist would accuse you of having committed a _____ _____.
12. The _____ school of psychology was founded by Dewey, and strongly influenced by the Darwinian revolution.
13. The _____ school of psychology shunned mentalistic concepts, and stressed the importance of studying the observable.
14. _____ was the man responsible for beginning the behaviorist revolution.
15. The focus of behaviorism is the study of _____.
16. The _____ school of psychology stressed that the perceptual experience was more than summing up of mental elements.
17. Shape constancy refers to the fact that the perceived shape of a object remains constant, despite changes in the shape of the _____ _____.
18. One of the goals of _____ is to find physiological correlates of psychological phenomena.

MULTIPLE CHOICE QUESTIONS

1. Which of the following argued that the mind could not be understood in physical terms?
   a. dualists
   b. empiricists
   c. functionalists
   d. structuralists

2. Decartes helped to weaken the dualist belief, by suggesting that
   a. mind could influence body
   b. body could influence mind
   c. each could influence the other
   d. neither could influence the other
3. British empiricist philosophers emphasized the importance of
   a. experience
   b. function
   c. innate ideas
   d. structure
4. Helmholtz's reaction-time experiment was based on the notion that reaction times should be shorter for _____ then for _____.
   a. adults, children
   b. visual stimulation, auditory stimulation
   c. intense stimulation, weak stimulation
   d. neck stimulation, foot stimulation
5. According to Weber's law, if you were holding a 50 pound barbell in your left hand and a 100 pound barbell in your right, you would notice an extra pound
   a. more easily in your left hand.
   b. more easily in you right hand.
   c. equally easily in either hand.
   d. in the hand closer to the brain.
6. The founder of psychophysics was
   a. Fechner
   b. Helmholtz
   c. Ebbinghaus
   d. Wundt
7. The person credited with founding the first laboratory of psychology was
   a. Fechner
   b. Helmholtz
   c. Weber
   d. Wundt
8. The founder of the structural school of psychology was
   a. Fechner
   b. Helmholtz
   c. Weber
   d. Wundt

9. Which of the following are **not** structuralistic elements of experience?
   a. affections
   b. associations
   c. ideas
   d. sensations
   e. all of the above are elements

10. The basic research technique used by the structuralists was
   a. correlation
   b. demonstrations
   c. introspection
   d. reaction-time experiments

11. A school of psychology that was influenced by the Darwinian revolution was
   a. behaviorism
   b. dualism
   c. functionalism
   d. gestalt psychology
   e. structuralism

12. The functional school of psychology was founded by
   a. Dewy
   b. Watson
   c. Wertheimer
   d. Wundt

13. A name associated with the behavioral school of psychology is
   a. Dewy
   b. Watson
   c. Wertheimer
   d. Wundt

14. The central focus of behaviorism came to be
   a. learning.
   b. perceptual demonstrations.
   c. psychophysics.
   d. reaction-time experiments.

15. Behaviorists emphasized the importance of studying
   a. mental elements.
   b. conscious experience.
   c. observable phenomena.
   d. all of the above

16. A name associated with Gestalt psychology is
    a. Dewy
    b. Watson
    c. Wertheimer
    d. Wundt
17. Gestalt psychology has been criticized because
    a. it places too much emphasis on mental elements.
    b. it relies on demonstrations rather than on experiments.
    c. it neglects perception and problem solving.
    d. it relies too much on experience.
18. The legacy of Gestalt psychology is greatest in the field of
    a. cognitive psychology
    b. human factors
    c. psychophysics
    d. psychophysiology
19. Contemporary experimental psychology is becoming increasingly
    a. general
    b. school oriented
    c. specialized
    d. both *a* and *b*

TRUE-FALSE QUESTIONS

____ 1. Most psychologists today subscribe to the tenets of dualism.

____ 2. British empiricists stress the importance of innate ideas.

____ 3. The roots of experimental psychology can be found in philosophy.

____ 4. Helmholtz abandoned psychological-type research because of large variability in reaction time data.

____ 5. According to Weber's law, sensation magnitude is a function of the log of the stimulus intensity.

____ 6. Wundt is considered to be the founder of psychophysics.

____ 7. According to the structuralists, images are the elements of experiences that are not actually present.

_____ 8. Gestalt psychologists relied heavily on the research technique of introspection.

_____ 9. Behaviorists would rather refer to habits than to mental states.

_____ 10. A rectangle viewed from the side produces a trapezoidal image on the retina.

_____ 11. Engineers, and not psychologists, are responsible for information theory.

_____ 12. Phrenology can be viewed as an early form of structuralism.

_____ 13. The American Psychological Association is the only professional organization for experimental psychologists.

Appendix B

Statistical Reasoning: An Introduction

IN OTHER WORDS

Statistics are numbers that we calculate from groups of numbers that tell us something about the groups. A **descriptive statistic** describes some property of the original numbers, and serves to summarize and organize the original raw data from a study. The property most often described is **central tendency**, which can be viewed as the value of the most typical score in a group of scores. The **arithmetic mean**, or simply the **mean**, is the most common measure of central tendency. The **median**, or middlemost score in terms of magnitude, is another useful measure of central tendency, and is preferred to the mean when there are a few extreme scores in the sample.

Another property of a group of scores is how dissimilar they are to one another; measures of **dispersion** measure this property. The best known measure of dispersion is the **range**, the difference between the highest and lowest scores in a sample. In practice the range is seldom used since it is based on the most extreme scores in a sample, the ones that are the least trustworthy. The average deviation is another measure of dispersion that is calculated by averaging the absolute differences between each score in a sample from the mean, **the absolute mean deviation**. **Variance** and the **standard deviation** are the most widely used measures of dispersion. Variance is calculated by finding the difference between each score in a sample and the sample mean, squaring these differences, summing these squares, and finally dividing by the number of scores in the sample. To return to the original units of measurement, the standard deviation is found by taking the square root of the variance.

The properties of central tendency and dispersion can be seen in graphic representations of the sample data. **Frequency distributions** plot score values on the abscissa, and the frequency with which each value was observed on the ordinate. A **histogram** is a frequency distribution drawn as a bar graph; a **frequency polygon** is similar to a histogram, except that the midpoints of each bar are connected.

A commonly observed shape of a frequency distribution is a **normal curve**: it is bell-shaped with most of the scores falling near the middle, and fewer scores occur at increasing distances from the middle values. Both the mean and the median have the value of the most frequent score in a normal distribution. The size of the standard deviation can be estimated by the distance between the mean and one of the **points of inflection** on the sides of the curve, the point where the curvature changes from bending downward to bending outward. The *z*-score is a useful statistic when it can be assumed that the distribution of scores is normal. The ***z*-score** is simply the number of standard deviations that a score lies above or below the mean, and it is useful measure of how unusual a score is.

When measurements of two different properties are taken for each subject, it is often of interest to determine how strongly these properties are related to each other. The **Pearson *r*** is the most commonly used **correlation coefficient**, a descriptive statistic used to describe the strength of relationships.

Psychologists perform experiments in order to make general statements that apply to more than the particular participants in the study, i. e., to a **population** of untested people that the tested **sample** represents. Experimental results are more likely to generalize if the sample is truly representative of the population. One way of achieving this is to use a **random sample**, in which each member of the population has an equal and independent chance of being included. Large random samples are more likely to represent the population than small samples.

A second issue in the ability to generalize experimental results is the reliability of these results, how sure that we can be that the same results would be obtained if the experiment were repeated. Experiments that use a large number of subjects yield more repeatable results than those that use a small number, and there is a statistical reason for this. We can imagine drawing many samples from some population, calculating the mean for each sample, and preparing a frequency distribution of these sample means. The shape of the **distribution of sample means** will be normal, with the mean of the sample means very close to the population mean. The standard deviation of this curve, called the **standard error of the mean**, is related to the size of the samples drawn; the bigger the sample, the smaller the

standard error of the mean. This means that, on the average, two sample means will be closer to each other if they are based on large rather than small samples.

Inferential statistics allow us to make inferences about the reliability of observed differences among sample means obtained from different groups in the same experiment. The logic used to make this inference is indirect. We start out with an **experimental hypothesis,** or alternative hypothesis, which is a statement of what we expect to happen in the experiment. We contrast this experimental hypothesis with a **null hypothesis** that says that any differences between means observed in the experiment were due to sampling error, and that there is no effect of the independent variable. We hope to be able to show that the actual experimental results would be very unlikely to have occurred if the null hypothesis were true. If the probability of obtaining the observed results by chance is low enough, (less than the **alpha level**) we reject the null hypothesis at that **level of confidence**, and claim support for the experimental hypothesis.

The nature of the alternative hypothesis has an influence on how we interpret statistical results. If the alternative hypothesis simply suggests that there will be a difference between the experimental and control groups, then we perform a **nondirectional test**, also called a **two-tailed test**. If the alternative hypothesis is that the mean of the experimental group will be larger than the mean of the control group, we do a **directional test, or** a **one-tailed test**. If the difference between means is in the predicted direction, it is easier to reject the null hypothesis with a one-tailed and a two-tailed test. Two-tailed tests are more conservative than one tailed tests, and are more generally used.

We can never be sure of our inferences; there is always some chance of making mistakes. The most serious mistake we can make is to reject the null hypothesis when it is true. This is called a **type I error**, and we control the likelihood of committing a type I error by selecting our alpha level. The less serious mistake is failing to reject the null hypothesis when it is false, called a **type II error**. **Power** is the probability of rejecting false null hypotheses. Some statistical tests are more powerful than others, and power is increased by using large samples.

The selection of an appropriate statistical test is determined by the experimental design; on the number of independent variables in an experiment, the number of levels of the independent variables, and whether comparisons are between-subject or within-subject. Another consideration is whether you are willing to assume that your data meet certain assumptions that particular statistics tests make about the properties (called **parameters**) of the populations represented by the experimental and control subjects. Common assumptions are that both populations

are normal, and have a similarly sized standard deviation (the assumption of **homogeneity of variance**). Tests that make these assumptions are called **parametric tests**, and those that don't are **nonparametric tests**.

There are a variety of tests that can be used for simple two-condition experiments. The ***t*-test**, which is the most widely used, is a parametric test, and there are versions for both **between-subjects designs**, and for **related measures designs** (used with both within-subjects and matched groups experiments). As with most tests, a value of *t* is calculated from data, and this is compared with a critical value of *t* that is associated with a particular alpha level and with the appropriate number of **degrees of freedom**, which is a function of the size of the sample. If the calculated *t* exceed the critical value. the null hypothesis may be rejected at the alpha level of confidence. It is also useful to calculate a measure of the **magnitude of effect** of the independent variable; for the *t*-test, this measure is the **point-biserial coefficient of correlation**. Nonparametric tests that are used for two-condition experiments include the **Mann-Whitney *U* test** for between-subjects designs, and the **sign test** and the **Wilcoxon signed-ranks test** for related measures designs.

The **analysis of variance** or ***F* test** is used to analyze the data from more complicated experiments. A **simple analysis of variance** is used for between-subjects experiments with more than two levels of a single independent variable. The levels of the independent variable may represent different amounts of something (**quantitative variation**), or they may differ in nature (**qualitative variation**). *F* is defined as a ratio of two independent estimates of the population variance (assuming the null hypothesis to be true). In a simple analysis of variance, one of these estimates is based on how much the group means differ from each other, and is called the **between-groups variance**. The other estimate is based on how much subjects within each group differ from each other, the **within-groups variance**. The *F* ratio is the between-groups estimate divided by the within-groups estimate. If the null hypothesis were true, then these estimates should be about the same, and the expected value of *F* would be around 1.00. On the other hand, if the null hypothesis were false and different levels of the independent variable produced different behavioral effects, the between-group estimate would be larger than the within-group estimate, and *F* would be greater than 1.00. If the value of *F* exceeds the critical value, the null hypothesis can be rejected. If a significant value of *F* is found, follow-up tests are useful to determine which specific levels of the independent variable differ from each other; this is especially useful if the levels of the independent variable differ qualitatively.

When an experiment includes more than one independent variable, the data should be analyzed with a **multifactor analysis of variance**. This kind of analysis evaluates the differences among the levels of each independent variable separately (**main effects**), and also determines whether there are any reliable interactions between different independent variables (**interaction effects**). There are no commonly used nonparametric test for multifactor experiments. Research has indicated, however that violations of the underlying assumptions of the analysis of variance do not greatly distort the results of the analysis. This property of the analysis of variance allows us to call it a **robust test**.

The chapter concludes with a discussion of various ways in which statistics can be misused. These include drawing conclusions from small or biased samples, exaggerating the scales on graphs in order to increase or decrease the apparent magnitude of a difference, making inappropriate comparisons, and assuming that the laws of probability, which hold for huge samples of observations, can be generalized to small samples. Statistics themselves do not lie, but they can be used to give misleading impressions.

KEYWORD MATCHING

1.

_____*F* test
_____Mann-Whitney *U* Test
_____nonparametric test
_____one-tailed test
_____robust test
_____sign test
_____*t*-test
_____two-tailed test
_____Wilcoxon signed-ranks test
_____what all of the above are, or pertain to

A. analysis of variance
B. descriptive statistics
C. directional test
D. inferential statistics
E. nondirectional test
F. nonparametric two-group between-subjects test
G. nonparametric two-group within-subjects test
H. parametric two-group test
I. test that is relatively unaffected by violation of underlying assumptions
J. test that make no assumptions about population characteristics

2.

_____Pearson *r*
_____mean
_____median
_____range
_____standard deviation
_____variance
_____z-score
_____what all of the above are examples of

A. a correlation coefficient
B. descriptive statistics
C. distance between mean and inflection point in a normal curve
D. inferential statistics
E. measure of central tendency influenced by extreme scores
F. measure of central tendency uninfluenced by extreme scores
G. measure of dispersion defined by extreme scores
H. number of standard deviations a score lies from the mean
I. the square of the standard deviation

3.

_____alpha level
_____experimental hypothesis
_____null hypothesis
_____power
_____type I error
_____type II error

A. ability of test to reject false null hypotheses
B. any difference between group means is due to sampling error
C. failing to reject a false null hypothesis
D. level of confidence
E. rejecting a true null hypothesis
F. testing this is the purpose of an experiment

4.

_____frequency polygon
_____histogram
_____normal curve
_____what the above are examples of

A. bell-shaped curve, frequently found for psychological measures
B. constructed by joining the midpoints of a histogram
C. frequency distribution
D. kind of bar graph

5.

_____between-groups design
_____between-groups variance
_____related measures design
_____within-groups variance

A. denominator of the *F* ratio
B. different subjects are used in each treatment
C. numerator of the *F* ratio
D. same or matched subjects are used in each treatment

6.

____interaction effect
____homogeneity of variance
____main effect
____mulitfactor analysis of variance
____simple analysis of variance

A. behavior is not the same at all levels of an independent variable
B. effects of one independent variable are not the same at all levels of a second independent variable.
C. underlying assumption of the *F* test
D. used when there is more than one independent variable in an experiment
E. used when there is more than two levels of one independent variable in an experiment

7.

____degrees of freedom
____parameter
____population
____qualitative variation
____quantitative variation
____random sample
____sample
____standard error of the mean
____statistics

A. characteristic of a population
B. number of numbers that are free to vary; related to sample size
C. experimental participants
D. kind of sample that is likely to represent population
E. levels of independent variable differ in amount
F. levels of independent variable differ in nature
G. numbers derived from a group of numbers to describe them, of allow inferences to be made about them
H. standard deviation of the distribution of sample means
I. untested people to whom experimental results should generalize

PROGRAMMED REVIEW

1. The main types of descriptive statistics are measures of _____ _____ and measures of _____.

2. One type of graphical representation of numerical data is a _____ or bar graph.

3. The histogram and the _____ _____ are both examples of _____ distributions.

4. The most common measure of central tendency in psychological research is the _____ _____.

5. The score that exceeds half the scores, and is exceeded by half the scores is called the _____.

6. A measure of central tendency that is relatively insensitive to extreme scores is the _____.

7. The difference between the highest and the lowest scores in the distribution is called the _____.

8. When calculating the mean deviation, it is necessary to use the _____ value of the difference between each score and the group mean.

9. The _____ of a distribution is defined as the sum of the squared deviations from the mean divided by the number of scores.

10. The square root of the variance gives us the _____ _____ of the distribution.

11. The formula for the variance is: s^2=_____

12. Psychologists typically present the _____ and the _____ when describing an array of data.

13. A useful property of the normal curve is that a specific _____ of the scores fall under each part of the curve.

14. If two normal distributions have different means and variances then one way to compare scores across these two distributions is to convert the scores to _____ scores or _____ scores.

15. If we calculate the difference between an individual score and the mean of the distribution from which that score was take, and then divide this difference by the standard deviation of the distribution, the resulting score represents a _____ score.

16. A complete set of measurements (or individuals or objects) having some common observable characteristic is called a _____. A subset of a population is called a _____.

17. It is important that samples be as _____ as possible of the population under study.

18. If one samples from a population by some completely arbitrary means, then this is called a _____ sampling procedure.

19. If we conducted an experiment and then replicated that same experiment many times, the distribution of the resultant sample means would tend to be a _____ distribution.

20. The standard deviation of a distribution of sample means is called the _____ _____ of the _____.

21. In general, we want the standard error of the mean to be as _____ as possible. One way to do this is to (increase/decrease) _____ the size of the sample.

22. In testing hypotheses we pit the _____ hypothesis against the _____ hypothesis.

23. The null hypothesis predicts that
_____
_____
_____
_____

24. If we know the standard deviation of the population then we can find the standard error of the mean by dividing the population standard deviation by the
_____.

25. If you are told that an observed difference was significant at the .05 level of confidence then this means
that_____
_____
_____
_____.

26. Rejecting the null hypothesis when it is actually true is called a _____ error, and the probability that this error is being made is indexed by the _____ level.

27. If we fail to reject the null hypothesis when it is in fact false, then we have committed a _____ _____ error.

28. Conservative statistical test minimizes type _____ errors.

29. The _____ of a test is the probability of rejecting the null hypothesis when it is actually false.

30. By increasing the _____ _____ we may increase the power of our test.

31. If the alternative hypothesis specifies the directionality of the expected difference, then a _____ - _____ test is used, but if the alternative hypothesis is nondirectional then a _____ - _____ test is used.

32. Two-tailed tests are more _____ and _____ powerful that one-tailed tests.

33. A _____ statistical test is one that makes assumptions about the underlying population parameters of the samples on which the tests are performed.

34. In general _____ tests are less powerful than _____ tests employed in the same situation.

35. The Mann-Whitney *U* test is used to analyze data from a _____ - subjects design. The Wilcoxon signed-ranks test is used to analyze data from a _____ - _____ design.

36. If a researcher used four levels of an independent variable and tested four separate groups of subjects, an appropriate statistical test for analyzing the date from this experiment would be a simple _____ of _____.

37. The *F*-test used in the analysis of variance is a ratio of the _____ -_____ variance estimate to the _____ -_____ variance estimate.

38. The null hypothesis predicts that the *F*-ratio should be _____.

39. In an experiment in which more than one factor is varied simultaneously the appropriate procedure for analyzing the results would be use a _____ _____ of variance.

40. A statistical test is a _____ test if violations of its assumptions are unlikely to lead to erroneous conclusions.

41. Whenever you hear about preferences that people have exhibited, what two questions should you ask yourself about the sample?
1._____
2._____

42. In order to avoid being mislead by graphically presented data it is important that you examine the _____ used to draw the graph.

43. The error inherent in the gambler's fallacy is that it is not appropriate to apply what is true over very _____ series of events to _____ series.

MULTIPLE CHOICE QUESTIONS

1. Descriptive statistics:
   a. summarize experimental observations
   b. tell which data are important
   c. indicate which differences are reliable
   d. all of the above

2. The mean is:
   a. the same as the arithmetic average
   b. the middle score
   c. the most common score
   d. the standard score
   e. the extreme score

3. The median is:
   a. the sum of scores divided by the number of scores
   b. the most frequent score
   c. the midpoint of the distribution of scores
   d. the range of scores

4. The primary reason the median is used is because:
   a. it is the most useful measure of central tendency
   b. it has the property of being insensitive to extreme scores
   c. it has the property of accurately reflecting the range of scores
   d. almost all inferential statistics are based on it

5. The simplest measure of dispersion in a group of scores is the:
   a. mode
   b. range
   c. standard deviation
   d. variance

6. A defining characteristic of the mean is that:
   a. an n increases, the mean increases
   b. the sum of the deviations of scores about the mean is always zero
   c. the mean deviation equals the mean divided by n
   d. the mean is always less than the average

7. The variance of a distribution is defined as the _____ divided by the number of scores.
   a. sum of the absolute deviations from the mean
   b. difference between the highest and lowest scores
   c. sum of the squared deviations from the mean
   d. sum of the absolute deviations from the median

8. The square root of the variance is the _____ deviation.
   a. standard
   b. average
   c. mean
   d. sample

9. In describing an array of data, psychologists typically present two descriptive statistics, which are the:
   a. median and variance
   b. median and standard deviation
   c. mean and the variance
   d. mean and the standard deviation

10. Which of the following is a characteristic of the standard normal distribution?
    a. the mean, median, and mode are the same
    b. the mean and median only are the same
    c. the median and mode only are the same
    d. the mean and mode only are the same
    e. none of the above

11. Approximately what percentage of scores in a normal distribution fall between plus and minus one standard deviation from the mean?
    a. 17%
    b. 34%
    c. 68%
    d. 96%
    e. 99.7%

12. Approximately what percentage of scores in a normal distribution have z values between -2.0 and +2.0?
    a. 17%
    b. 34%
    c. 68%
    d. 96%
    e. 99.7%

13. Inferential statistics are concerned with:
    a. the importance of data
    b. the meaning of data
    c. the reliability of data
    d. all of the above

14. Characteristics of a population of scores are called _____, while characteristics of a sample of scores drawn from a larger population are _____.
    a. statistics; parameters
    b. parameters; statistics
    c. generalizations; data
    d. inferences; facts

15. The distribution of sample means tends to be:
    a. normal
    b. exponential
    c. Poisson
    d. random

16. The standard error of the mean is the:
    a. square root of the mean
    b. mean of a distribution of sample means
    c. variance of a distribution of sample means
    d. standard deviation of a distribution of sample means

17. The standard error of the mean represents the error we have in assuming that the:
    a. mean represents the sample mean
    b. sample mean represents the population mean
    c. standard deviation of the sample mean is accurate
    d. standard deviation of the population mean is accurate

18. As the sample size (n) increases, the:
    a. sample mean increases
    b. standard error of the mean increases
    c. standard error of the mean decreases
    d. standard deviation of the mean increases

19. The null hypothesis suggests that the two samples come from:
    a. the same distribution
    b. different distributions
    c. different but overlapping distributions
    d. different but similar distributions

20. Adopting a .05 level of confidence means that you would:
    a. accept the null hypothesis if the results could occur 5 times in a 100 by chance
    b. reject the null hypothesis if the results could occur 5 times in 100 by chance
    c. reject the experimental hypothesis if the results could occur 5 times in 100 by chance
    d. none of the above

21. An experimental psychologist reports that his statistical test indicates that the difference between his experimental and control groups in his latest experiment is highly significant. By this he means that:
    a. the difference was highly unlikely to have occurred by chance
    b. the difference was probably due to chance factors
    c. the results are very important
    d. both a and c

22. Rejecting the null hypothesis when it is actually true is a:
    a. type I error
    b. type II error
    c. type III error
    d. standard error

23. A type I error occurs when you:
    a. reject a false null hypothesis
    b. reject a true null hypothesis
    c. reject a true experimental hypothesis
    d. accept a false null hypothesis

24. A type II error occurs when you:
    a. reject a true null hypothesis
    b. fail to reject a false null hypothesis
    c. reject a false null hypothesis
    d. fail to reject a true null hypothesis
    e. fail to reject a false experimental hypothesis

25. In hypothesis testing, both the magnitude of the difference and the direction of the difference between two groups are considered in:
    a. two-tailed tests
    b. one-tailed tests
    c. parametric tests
    d. nonparametric tests

26. Parametric tests:
    a. do not make assumptions about the underlying population parameters
    b. make assumptions about the underlying population parameters
    c. are typically more powerful than nonparametric tests
    d. both b and c

27. The Mann-Whitney *U* test can only be used for:
    a. within-subjects designs
    b. between-subjects designs
    c. related measures designs
    d. none of the above

28. For the sign test:
    a. the magnitude of the difference between paired scores of the two groups is all that matters
    b. the direction of the difference between the paired scores is all that matters
    c. both the magnitude and the direction of the difference matter
    d. neither the magnitude nor the direction on the difference matters

29. In an analysis of variance, the *F* ratio under the null hypothesis should be:
    a. 0.0
    b. +1.0
    c. -1.0
    d. a random number
    e. we can't say; it depends on the degrees of freedom

30. In an analysis of variance, the _____ the number of degrees of freedom, the _____ the value of the *F* ratio needed to reject the null hypothesis at the .05 level of confidence.
    a. greater; smaller
    b. smaller; smaller
    c. greater; greater
    d. the required value of *F* depends on the confidence level, not the degrees of freedom
    e. it depends on whether the test is a one- or two-tailed test.

TRUE-FALSE QUESTIONS

____1. Another name for a histogram is a frequency polygon.

____2. The most common measure of central tendency is psychological research is the mean.

____3. Extremely small or large scores have an effect on the mean, but not on the median.

____4. The mean of a set of scores has the property that the mean deviations from the mean add up to zero.

____5. The standard deviation is simply the square root of the variance.

____6. A property of the standard normal distribution is that the mean and the median are different.

____7. A *z*-score is the difference between an individual score and the mean expressed in units of standard deviation.

____8. A population is a complete set of measurements (or individuals or subjects) having some common observable characteristics.

____9. The distribution of sample means is not a normal distribution.

____10. As the sample size (n) increases, the standard error of the mean decreases, the power of the statistical test increases, and the probability of a Type II error decreases.

____11. The null hypothesis maintains that the two samples of scores (experimental and control) come from two different underlying distributions.

____12. Adopting a .05 level of confidence means that you would accept the null hypothesis if the obtained difference could occur 5 times in 100 by chance.

____13. A type I error is rejecting the null hypothesis when it is actually true.

____14. A liberal statistical test minimizes the probability of making a type II error.

____15. One way to increase the power of a statistical test is to increase the sample size.

____16. A two-tailed statistical test considers both the magnitude of the difference and the direction of the differences between two groups.

____17. Nonparametric tests are those that make assumptions about the underlying population parameters while parametric tests do not make such assumptions.

____18. A simple analysis of variance (ANOVA) uses only one dependent variable whereas a complex or multifactor Anova uses more than one dependent variable.

____19. In an analysis of variance, the *F* ratio under the null hypothesis should equal 0.00.

Answer Key

CHAPTER 1- EXPLANATION

Matching

1. E, B, A, D
2. H, F, A, D, C, E
3. C, E, D, A
4. C, B, D
5. C, B, A
6. A, B, C, D

Programmed Review

1. social loafing	p. 1
2. authority	p. 5
3. tenacity	p. 6
4. a priori	p. 6
5. empirical observation	p. 7
6. empirical, self	p. 7
7. description, prediction, explanation	p. 7
8. description	p. 7
9. prediction	p. 8
10. experimentation	p. 8
11. quasi-experiment	p. 8
12. organization, prediction	p. 10
13. data, theory, deductive	p. 10
14. inductive	p. 11
15. deductive	p. 11
16. falsified	p. 11
17. organizing	p. 11
18. predictions	p. 11
19. precise	p. 14
20. description, explanation	p. 10

21. independent, dependent p. 14
22. intervening p. 15
23. parsimony p. 14
24. precision p. 14
25. tested p. 14
26. basic, applied p. 17
27. processes p. 19

Multiple Choice

1. b p. 1
2. b p. 5
3. b p. 5
4. a p. 6
5. b p. 6
6. d p. 7
7. d p. 7
8. c p. 7
9. a p. 8
10. b p. 8
11. e p.11
12. b p.11
13. a p.11
14. d p.12
15. a p.14
16. c p.14
17. d p.14
18. c p.14
19. d p. 14
20. d p. 14
21. d p.14
22. c p.14
23. c p. 18
24. b p. 18
25. c p. 19

True-False

1. T p. 5
2. F p. 6
3. T p. 7
4. F p. 7
5. F p. 8
6. F p. 8
7. T p. 8
8. T p. 8
9. T p. 9
10. F p.10
11. T p.11
12. T p.11
13. T p.11
14. T p.14
15. T p.15
16. F p.14
17. T p. 14
18. F p. 15
19. T p. 14
20. T p. 14
21. F p. 18
22. F p. 19
23 T p. 19
24 F P. 19

CHAPTER 2 - OBSERVATION AND CORRELATION

Matching

1. B, C, F, D
2. A, C, D, E, F
3. C, F, E, D
4. D, C, B, A
5. A, C, E
6. D, B, A, C

Programmed Review

1.	science	p. 23
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25.	differences	p. 42
26.	time	p. 42
27.	time consuming	p. 43

Multiple Choice

1. d	p. 26	7. c	p. 32	13. a	p. 40
2. a	p. 26	8. b	p. 32	14. b	p. 37
3. a	p. 28	9. a	p. 34	15. d	p.39
4. b	p. 29	10. b	p. 35	16. b.	p. 35
5. d	p. 29	11. a	p. 35	17. c	p.42
6. d	p. 30	12. b	p. 35		

True-False

1. F p. 23
2. T p. 24
3. T p. 28
4. F p. 30
5. T p. 29
6. T p. 30
7. T p. 30
8. F p. 31
9. T p. 31
10. T p. 31
11. T p. 32
12. T p. 32
13. F p. 33
14. T p. 35
15. F p. 35
16. F p. 35
17. T p. 35
18. F p. 38
19. T p. 37
20. F p. 38
21. T p. 38
22. F p. 39
23. F p. 40
24. T p. 42

CHAPTER 3 - EXPERIMENTS

Matching

1. C, E, D, A
2. C, A, E, G, B
3. F, A ,D, B, E
4. E, D, A, B
5. D, A, B. E

Programmed Review

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4. two p. 49
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Matching

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True-False

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Matching

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10. d p. 247
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True-False

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4. T p. 249
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6. T p. 260
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Matching

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3. A, D, C
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7. B, G, C, H, F, E, D, I, A

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Matching

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3. F p. 321	12. T p. 325	21. T p. 334
4. F p. 321	13. T p. 327	22. F p. 335
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6. T p. 322	15. T p. 327	24. F p. 337
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Matching

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3. C, A, E, D, F, B
4. C, D, E, B, A
5. A, F, C, B, E, G, D
6. A, C, D, B

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6. d p. 352
7. b p. 354
8. d p. 355
9. b p. 357
10. d p. 357
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12. c p. 356
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1. T p. 352
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3. F p. 353
4. T p. 355
5. T p. 357
6. T p. 357
7. F p. 357
8. F p. 357
9. F p. 357
10. F p. 358
11. F p. 357
12. T p. 356
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15. T p. 359
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Matching

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9. d p. 388
10. b p. 388
11. d p. 388
12. c p. 388
13. c p. 389
14. d p. 389
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16. d p. 389
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True-False

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4. T p. 385
5. F p. 385
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20. F p. 400
21. T p. 398

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15. F p. 389
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Matching

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1. D, F, E, B, A, C

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Matching

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Multiple Choice

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2. b p. 442
3. e p. 442
4. c p. 443
5. a p. 444
6. b p. 446
7. c p. 447
8. c p. 448
9. b p. 452
10. c p. 453

True-False

1. F p. 442
2. F p. 443
3. T p. 445
4. F p. 444
5. T p. 446
6. F p. 446
7. T p. 448
8. F P. 452

APPENDIX A - HISTORICAL SKETCH

Matching

1. F, A, E, C, B, H, G, D
2. B, A, C, D
3. C, D, F, E, A, G, B

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Multiple Choice

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2. c p. 461
3. a p. 462
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5. a p. 464
8. d p. 465
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11. c p. 467
12. a p. 467
15. c p. 468
16. c p. 469
17. b p. 470
18. a p. 470
19. c p. 472

6. a p. 465
7. d p. 465
13. b p. 468
14. a p. 468

True-False

1. F p. 462
2. F p. 462
3. T p. 461
4. T p. 463
5. T p. 464
6. F p. 465
7. T p. 466
8. F p. 469
9. T p. 468
10. T p. 469
11. T p. 471
12. F p. 472
13. F p. 473

APPENDIX B - STATISTICAL REASONING

Matching

1. A, F, J, C, I, G, H, E, G, D
2. A, E, F, G, C, I, H, B
3. D, F, B, A, E, C
4. B, D, A, C
5. B, C, D, A
6. B, C, A, D, E
7. B, A, I, F, E, D, C, H, G

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43. long, short p. 520

Multiple Choice

1. a p. 477
2. a p. 479
3. c p. 479
4. b p. 479
5. b p. 480
6. b p. 480
7. c p. 481
8. a p. 481
9. d p. 482
10. a p. 484
11. c p. 484
12. d p. 484
13. c p. 488
14. d p. 489
15. a p. 490
16. d p. 492
17. b p. 492
18. c p. 492
19. a p. 493
20. b p. 494
21. a p. 494
22. a p. 497
23. b p. 497
24. b p. 497
25. b p. 499
26. d p. 500
27. b p. 500
28. b p. 502
29. b p. 510
30. a p. 510

True-False

1. F p. 478
2. T p. 479
3. T p. 479
4. T p. 480
5. T p. 481
6. F p. 484
7. T p. 485
8. T p. 489
9. F p. 490
10. T p. 498
11. F p. 493
12. F p. 494
13. T p. 497
14. F p. 497
15. T p. 498
16. F p. 499
17. F p. 499
18. F p. 500
19. F p. 510

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